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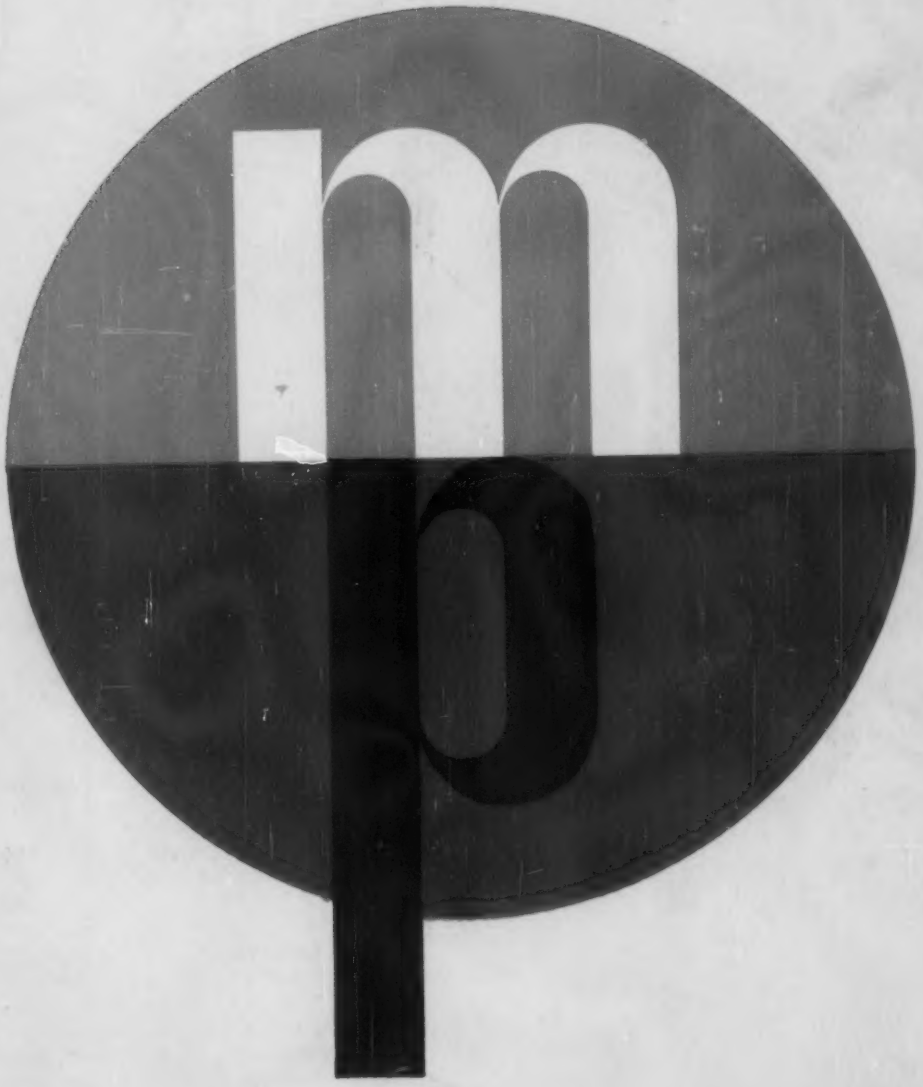

May 1957

page 107 Sheet forming today—markets and methods. With materials chart

page 125 How to estimate production costs on reinforced plastics jobs

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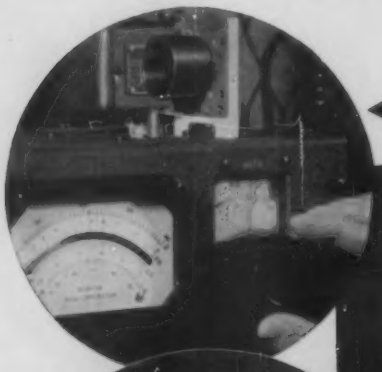

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Panelyte

MODERN PLASTICS*

Volume 34
May 1957
Number 9

● Editorial

5 Processor participation

● The Plastiscope

41 Section 1
250 Section 2

● General Section

107 Progress report on sheet thermoforming
Potential market for 175 to 200 million lb. of sheeting foreseen by 1965.
Wall chart of manufacturers of thermoplastics sheet inserted loose between pp. 108 and 109

112 Adhesive in film form
New pressure-sensitive product is versatile, easy to use

115 Color for phenolics
Thanks to new epoxy resins, the work-horse takes on beauty

117 Polyethylene film in construction
Rapid growth and prospects for the future of polyethylene film
By William Schopflin

121 Vinyl fishing lures
Vari-colored plastisols and simple aluminum molds are included in new hobby kit

122 Big cold box
Molded of expandable styrene beads, new container provides more efficient refrigeration for shipping and storing specialty products

126 Printed mulch
For the backyard gardener, black polyethylene film now comes with a grid for proper spacing of seedlings in a weedless garden

128 At the 1957 National S.P.I. Conference and First Pacific Coast Exposition

132 Plastics Products
Pump for inflatables; floor tile that sticks; compression molded occasional tables

● Plastics Engineering

135 Estimating for reinforced plastics
Standardized estimating procedures based on past data help to make sound estimates that keep both fabricator and customer happy. *By Frank W. Sheffler*

151 Recent trends in photoelastic plastics
New resins provide the design engineer with a versatile tool for predicting behavior of materials under loads
By M. M. Leven and R. C. Sampson

● Technical Section

157 Permeability of polyethylene to gases and vapors
By A. W. Myers, C. E. Rogers, V. Stannett, and M. Szwarc

168 Thermal conductivity of a plastic honeycomb sandwich
By Melvin Mark

170 Stabilization of plastics
By George H. Taft

181 Resin emulsion density-solids relationships
By Leonard Shapiro

● Departments

182 Plastics Digest
188 U. S. Plastics Patents
192 New Machinery and Equipment
198 Books and Booklets
212 Plastics Production
214 The Platform
229 Manufacturers' Literature
275 Companies . . . People
294 Classified Advertising
300 Index to Advertisers

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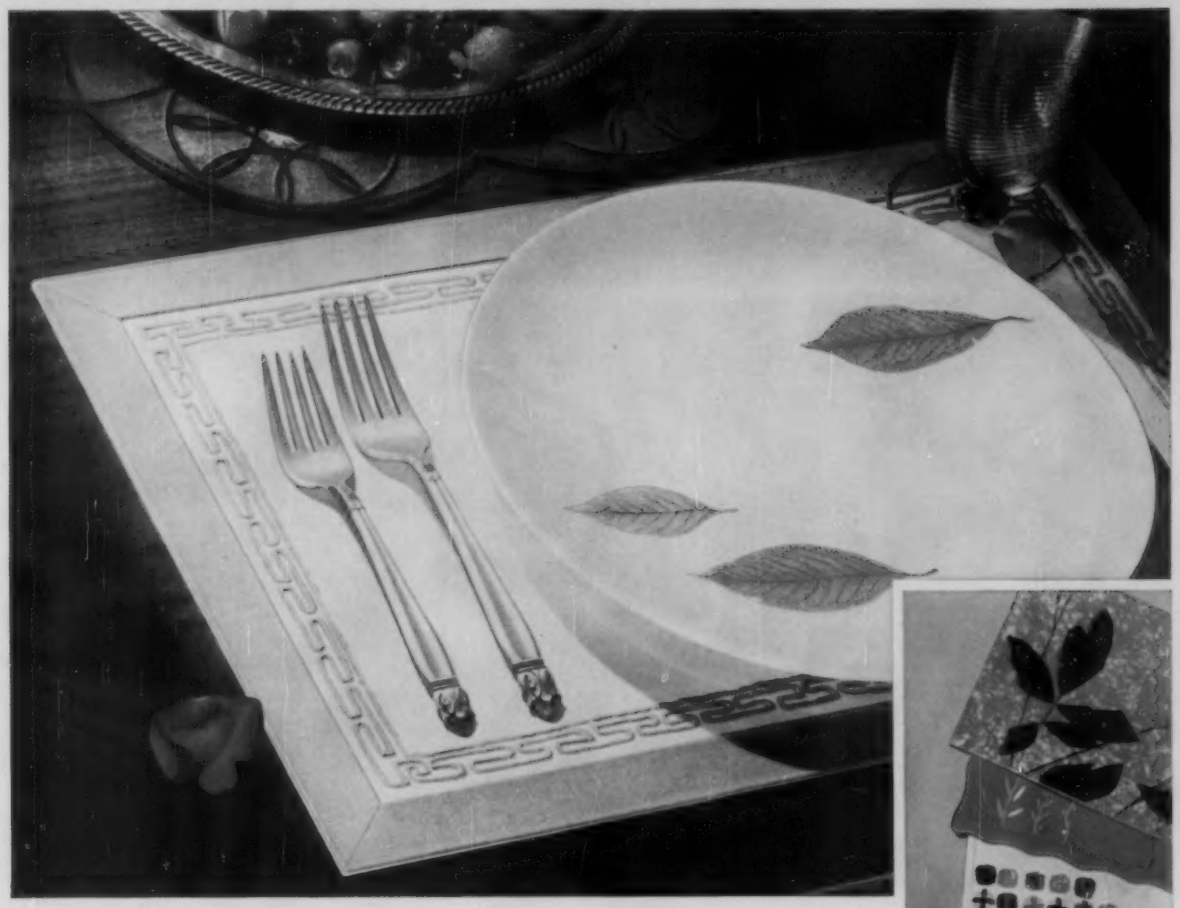

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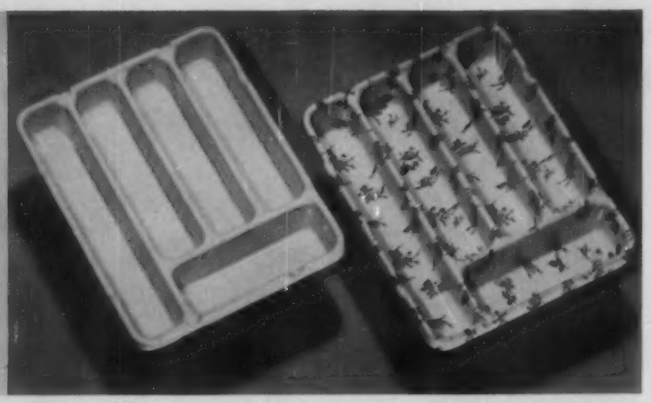

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Editorial

Processor participation

Two letters appearing in "The Platform," this issue, p. 214, point up a situation of increasing concern to everyone in the plastics industries. One letter is from the Chairman of the Speakers Committee of the S.P.E. 1958 Annual Technical Conference; the other is from the Program Chairman of the 1958 Conference of the Reinforced Plastics Div. of S.P.I. If the chairmen of all the plastics conferences to be held the rest of this year and in 1958 were to write us, we are sure the tenor of their letters would be the same: there must be more conference participation on the part of processing companies—molders, extruders, fabricators.

An analysis of the 1957 S.P.E. Conference shows that material makers sponsored 61% of all the events, processors and fabricators 11%, machinery and equipment makers 9%, consulting and educational organizations 12%, and end-users' laboratories 7 per cent.

At the 1957 Reinforced Plastics Conference material makers presented 33% of the papers, processors, 28%, military and government facilities 30%, while the other 9% was made up of papers from consultants, end-users, laboratories, etc.

At the 1957 National S.P.I. Conference in Los Angeles material suppliers dominated 52% of the program, processors 24%, with the other papers involving personnel from consulting organizations, the armed services, and, again, end-users' laboratories.

Yet in the exhibit booths, in the smoke-filled entertainment suites, in bars, and at luncheons any good industrial reporter who keeps his ears open learns two important facts: a) that the processors are constantly complaining about "platform selling" on the part of material makers, and b) that a vast amount of engineering knowledge and ability rests (and we do mean *rests*) in the engineering departments of the molders, extruders, and other processors.

Germane to the same proposition is the attitude of many processors toward committee work. Except where their individual selfish business interests are concerned (and sometimes not even then), they are generally unwilling to contribute time and personnel to committees.

The industry's Standards Committees, the various ASTM Committees, the Public Relations Committees—yes, even Program Committees suffer from lack of processor participation.

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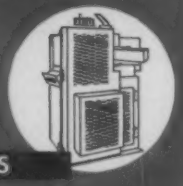

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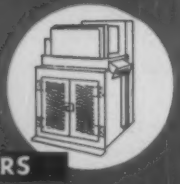

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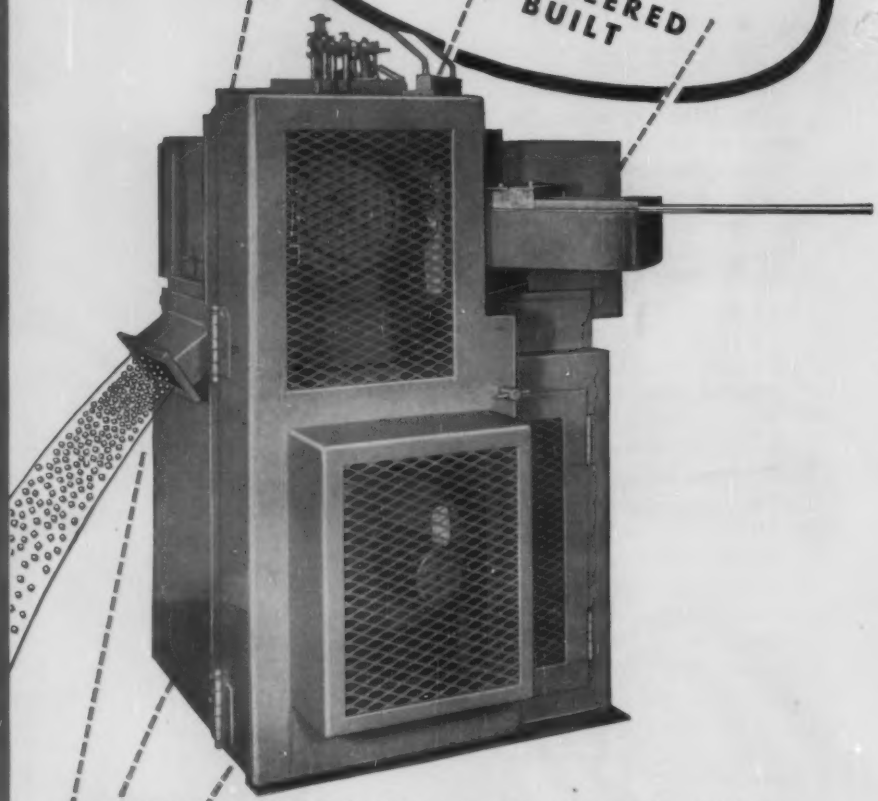

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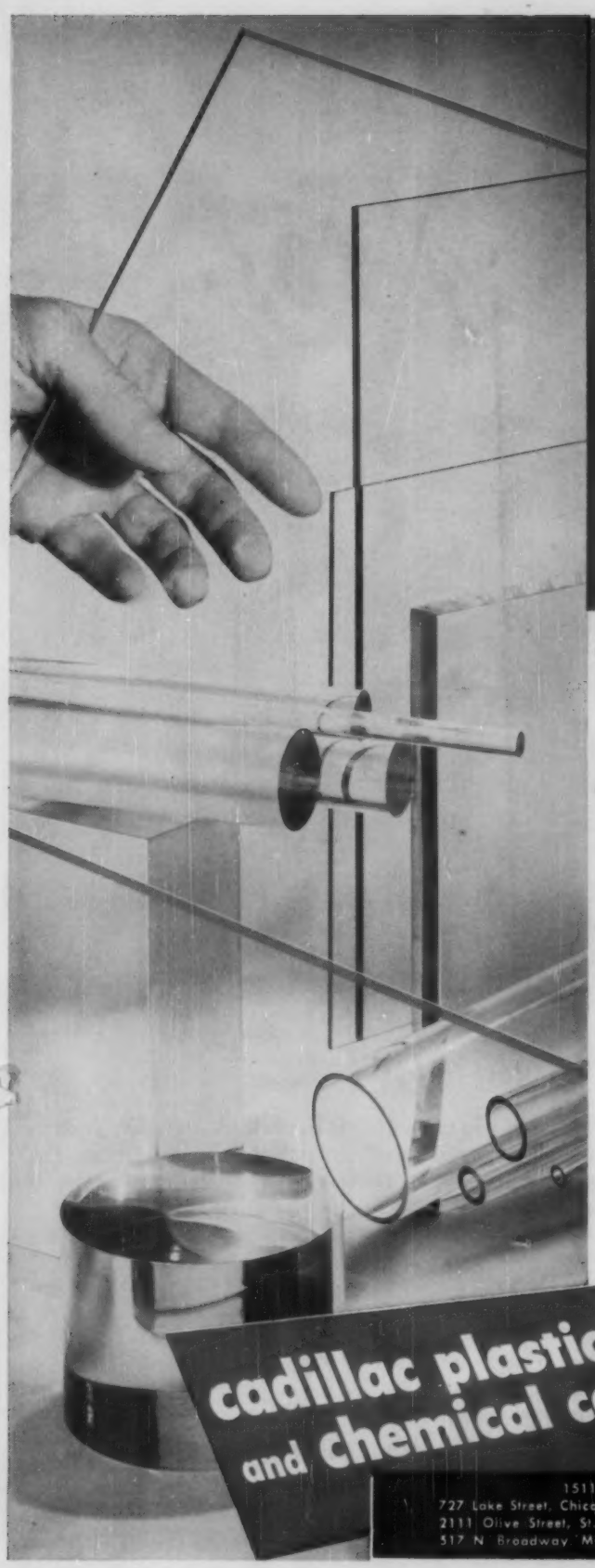

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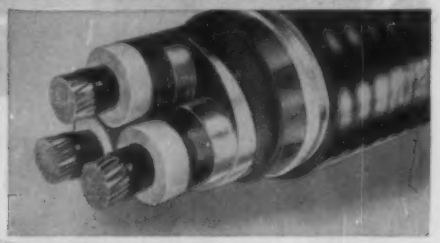

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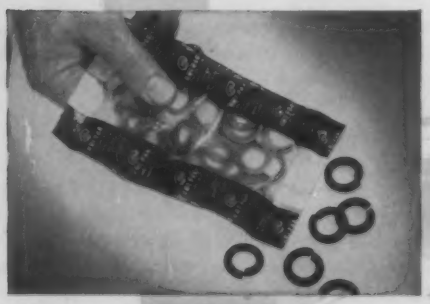

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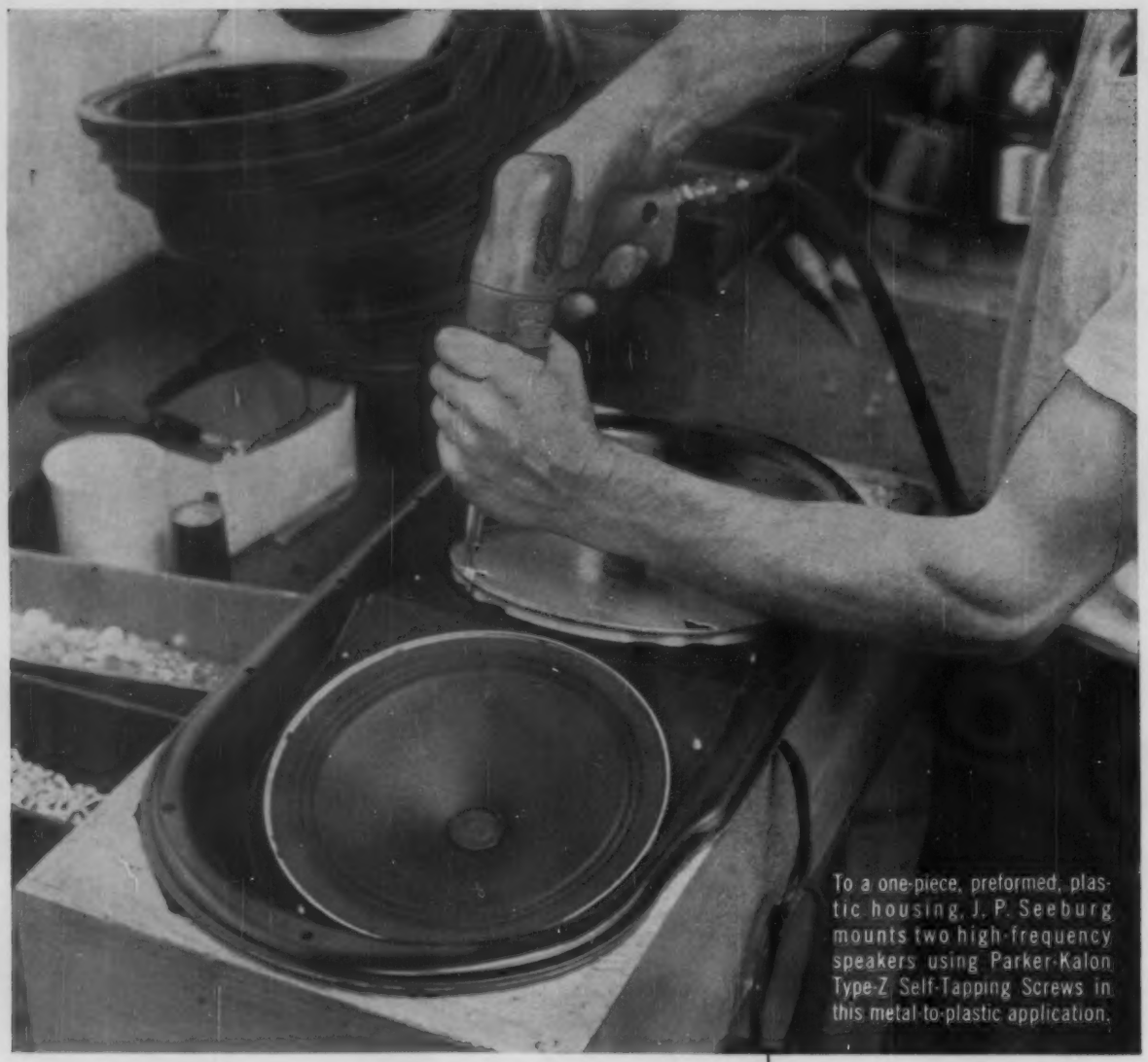

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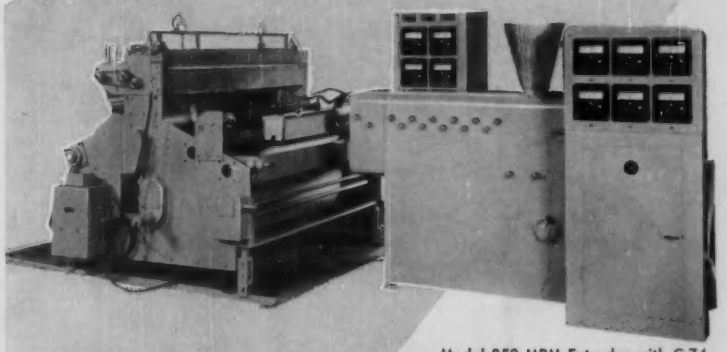

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Illustrated is just one example of the standard "packaged unit" we produce and supply together with specially designed equipment to fit your own specific needs. In many cases we deliver *complete* plants including dies and every piece of equipment required for the manufacture of your product.

Thirty three of the country's foremost resin manufacturers recognize MPM extruders for their exceptional versatility and reliability and therefore use them for extruding experimental thermoplastic compounds and for development work on behalf of their customers. MPM equipment is in use in 32 foreign countries.

We Welcome Inquiries and are prepared to demonstrate and instruct you in the operation of the completed installation before shipment. Such cooperation has in the past enabled many manufacturers without previous experience to operate profitably from the very first.

modern plastic machinery corp.

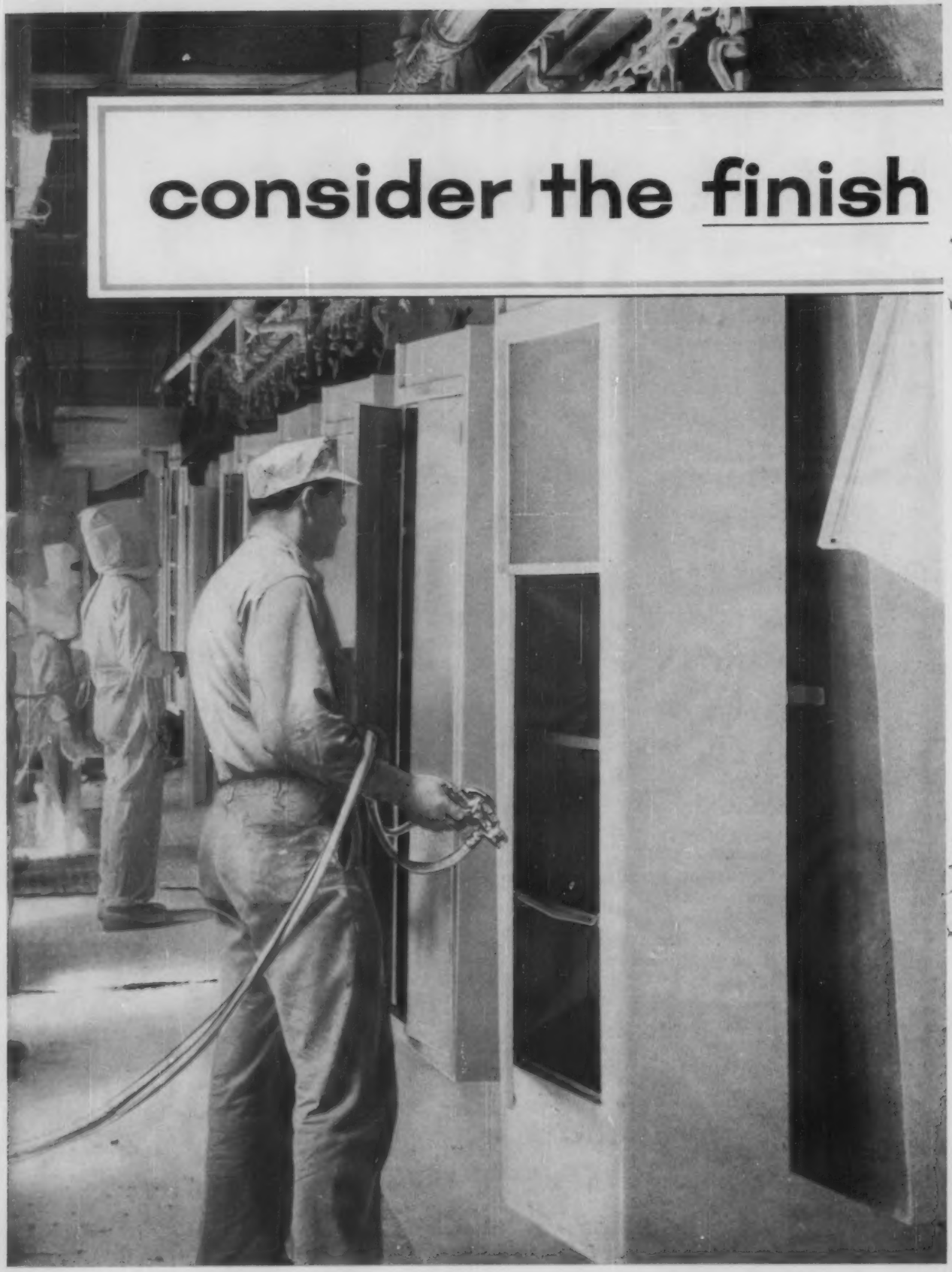
Manufacturers and Designers of

THE MOST ADVANCED PLASTIC PROCESSING EQUIPMENT

15 Union St., Lodi, N. J., U.S.A. • Cable Address: MODPLASEX

IN USE IN THE UNITED STATES AND THROUGHOUT THE WORLD

West Coast Representative: 4113 West Jefferson St., Los Angeles 16, Calif.


consider the finish

before you start

Metal coatings based on vinyl organosols comprise a relatively new, but fast-growing field.

Some of the reasons for the success of metal coating organosols include: 1. Their resistance to abrasion, abuse, corrosion and age. 2. Their ability to withstand postforming of the coated part. 3. Their lower cost than solution coatings. 4. Their faster application to a given thickness. 5. Their adaptability to a greater range of pigmentations and decorative effects.

If you are thinking of entering the metal coating field, there are good reasons why you should consider basing your finishes on PLIOVIC AO – the unique copolymer vinyl dispersion resin by Goodyear.

In organosols for metal finishing, PLIOVIC AO offers these advantages over other vinyl dispersion resins: 1. Up to 33% less grinding time. 2. Faster fusing at a given temperature. 3. Greater adhesion. You also get excellent heat and light stability, excellent viscosity stability and full sprayability with PLIOVIC AO.

The advantages of PLIOVIC AO in dispersion work stem from its unique composition and have been thoroughly established through its wide use, particularly in fabric coatings. Full details, including the latest *Tech Book Bulletins*, on how PLIOVIC AO gives you better coatings for metal or fabrics at lower cost are yours by writing to:

Goodyear, Chemical Division, Akron 16, Ohio

PLASTICS DEPARTMENT

CHEMICAL GOODYEAR DIVISION

CHEMIGUM • PLIOFLEX • PLIOLITE • PLIO-TUF • PLIOVIC • WING-CHEMICALS

High Polymer Resins, Rubbers, Latices and Related Chemicals for the Process Industries

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For Flawless Blown Film

complete installations for lay-flat tubing up to 55" double width

For extra heavy Requirements

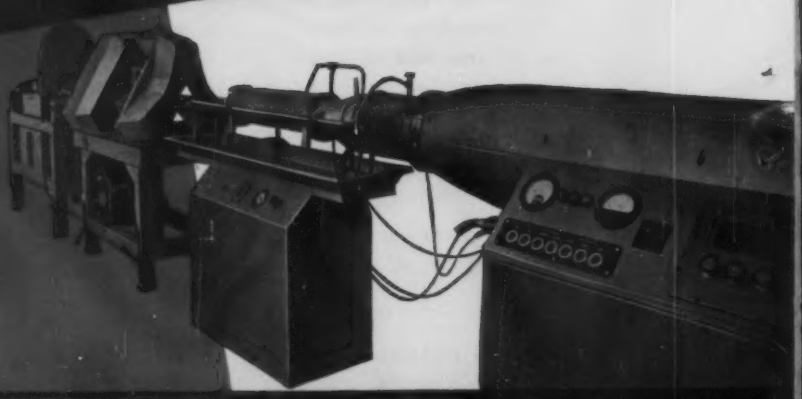
our 6 inch extruder, model S-150 in 25 : 1 La/D ratio incl. temperature control cabinet and recorder

For Uniform Flat Film

complete installations for flat film up to 60" width, incl. combined take-off-trimming- and wind-up equipment

For Calibrated Pipes

complete installations for pipes : our 3½" extruder, model S 90 RGV in 20 : 1 La/D ratio, incl. control cabinet, patented calibrating device, pipe haul-off and cutting device



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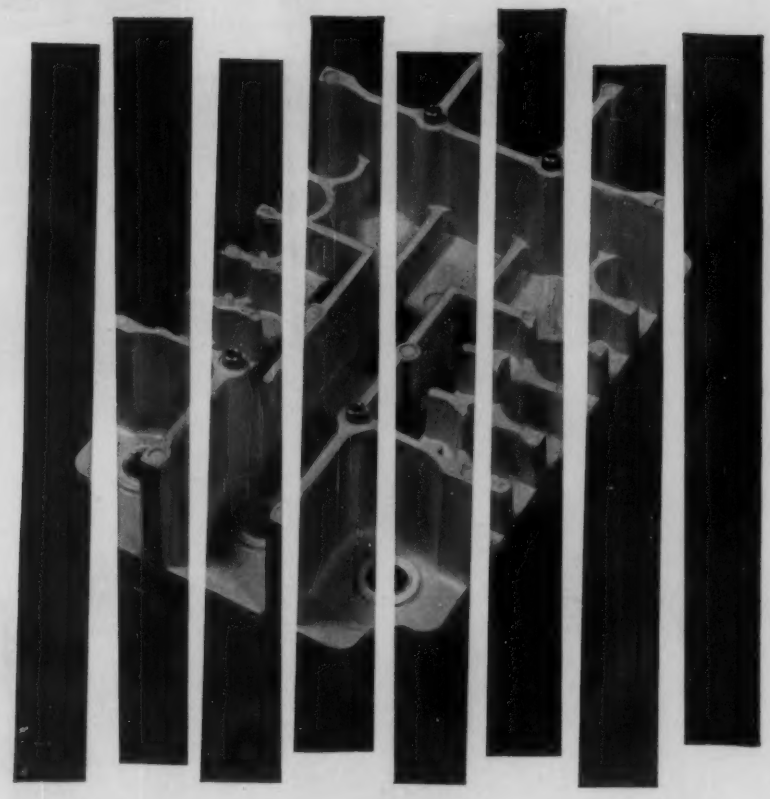
MASCHINENFABRIK

TROISDORF • WEST GERMANY



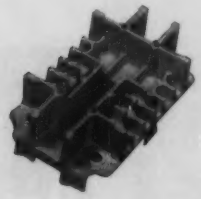
take another look... at plastic molding deliveries

(1) Production schedules based on realistic appraisals of capacity. (2) Presses and personnel experienced in keeping out of trouble. (3) Standby utilities to insure that presses stay running. (4) Specialization in one field of plastic molding. (5) Our own tool facilities with the people and equipment to build molds right the first time, and keep them that way.

These are the safeguards that make Kurz-Kasch delivery promises as reliable as you can get. Take the part shown above.

It meets a rather tight set of dimensional, physical, and electrical specifications, and it was shipped on a schedule that made the customer as happy as the performance of the part itself.

For a quote you can depend on . . . call Kurz-Kasch.



Specialists in thermo-setting plastics for 41 years

kurz-kasch

Kurz-Kasch, Inc., 1415 S. Broadway, Dayton 1, Ohio

SALES OFFICES—New York, Mt. Vernon, Mo 4-4866; Rochester, Hillside 0626; Beverly, Mass., Walker 2-0065; Chicago, Merrimac 7-1830; Detroit, Jordan 6-0743; Philadelphia, Hilltop 6-6472; Dallas, Lakeside 6-5233; San Gabriel, Cal., Atlantic 7-9633; St. Louis, Parkview 5-9577; Atlanta, Cedar 7-5516; Toronto, Can., Oliver 7986

Forticel Cabinet molded for Zenith by Plastic Molded Products Company, Chicago

These are the balanced properties that are giving Forticel its reputation as a "designer's plastic."

TYPICAL PHYSICAL PROPERTIES OF FORTICEL

Flow temperature:		
(°C.) (A.S.T.M.)	D569-48	167—178
Specific gravity	D176-42T	1.18—1.21
Tensile properties:		
Yield (p.s.i.)	D638-52T	3380—5020
Break (p.s.i.)	D638-52T	3470—5240
Elongation (%)	D638-52T	56—66
Flexural properties:		
Flexural strength (p.s.i. at break)	D790-49T	6400—8500
Flexural modulus (10^5 p.s.i.)	D790-49T	0.23—0.30
Rockwell hardness:		
(R scale)	D785-51	62—94
Izod impact:		
(ft. lb./in. notch)	D256-43T	2.7—11.0
Heat distortion:		
(°C.)	D648-45T	59—70
Water absorption:		
% sol. lost	D570-42	0.00—0.08
% moisture gain	D570-42	1.3—1.8
% water absorption	D570-42	1.6—1.8

ZENITH *selects* FORTICEL

new Celanese propionate thermoplastic for its all-transistor portable

The heart of the new Zenith 800 is a remarkable 100% transistor circuit that delivers full room power, tone-true reception.

But what first attracts the eye is its satin-smooth, plastic cabinet—molded of the new Celanese thermoplastic Forticel.

Forticel was created and engineered for just such demanding applications ... places where beauty and precision are twin specifications ... where Forticel's qualities of moldability, superb surface finish, high impact strength, form retention and freedom from objectionable odor can contribute to ready consumer approval as well as manufacturing efficiencies.

We urge you to inspect the new Zenith 800 at your favorite radio shop, and see one of the most skillfully engineered circuits in Zenith history ... and one of the most carefully engineered thermoplastics in service today. You will understand why Forticel has been welcomed by the molder and designer, and why it is being specified for an increasing number of famous name products.

Send for Product Bulletin NP-16. Use coupon below.

Celanese Corporation of America, Plastics Division
Dept. 101-E, 290 Ferry Street, Newark 5, N. J.

Send me New Product Bulletin NP-16 on Forticel Plastic.

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ADDRESS_____

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Celanese plastics

Celanese® Forticel®

Why Leading Injection Molders Are Switching to*

IMS TROUBLE FREE **HEATING CYLINDERS**

You Can Reduce Maintenance Costs and Increase Production Rate up to 50 Percent with an IMS Extra Capacity Heater

Here is a 20-oz. 17,000 watt oversize heater we installed on a Reed 8. Cost? Only $1995.00 complete. Yes, it's a fact! On HPM, WATSON-STILLMAN, FELLOWS, LEWIS and other makes, too, IMS UNIFORM DESIGN HEATERS are reducing down-time and increasing production. More than 800 now in active service. You'll be surprised at the new life you can get from an old machine with an IMS EXTRA CAPACITY LEAK-PROOF SUPERHEATER!

For use on all models of HPM, LESTER, REED, DE MATTIA, WATSON, Etc., Etc.

INJECTION MOLDERS SUPPLY CO.

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*We can tell you which leading injection molders are using IMS heaters. But we can't ask them to disclose what competitive advantages they have gained using IMS Replacement Cylinders. Install an IMS Superheater and see for yourself. Over 800 now in use.

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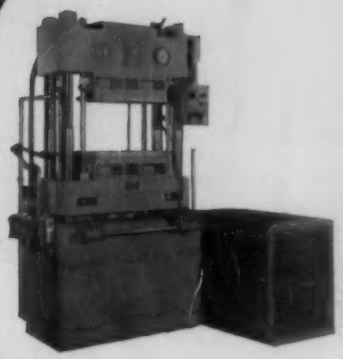
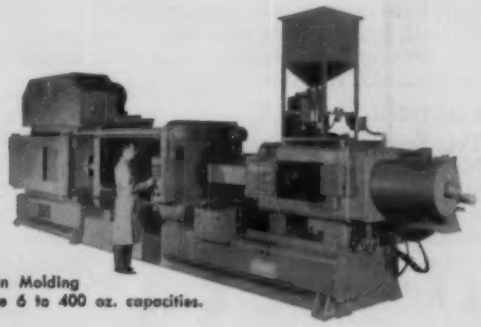


H-P-M Compression and Transfer Molding Presses 100 to 500 ton capacities, up to 2500 tons on special order.



Plastic Injection Molding Machine 6 to 400 oz. capacities.

Unlike many anniversaries that are built to exaggerated proportions, H-P-M is entering its eighty-first year with a minimum of interest in the past. Instead our research and development have geared our efforts to a program for the future. We like to feel that throughout our long and varied experience we have learned to anticipate the needs of the many industries with which we work. It is their future that guides our planning and our policies for the days ahead. This thinking has traditionally guided H-P-M to its present position as a leader in the hydraulic industry. Our goals will be changed only to provide more and better service to the industries we serve.

HPM

THE HYDRAULIC PRESS MFG. CO.

Mount Gilead, Ohio, U.S.A.

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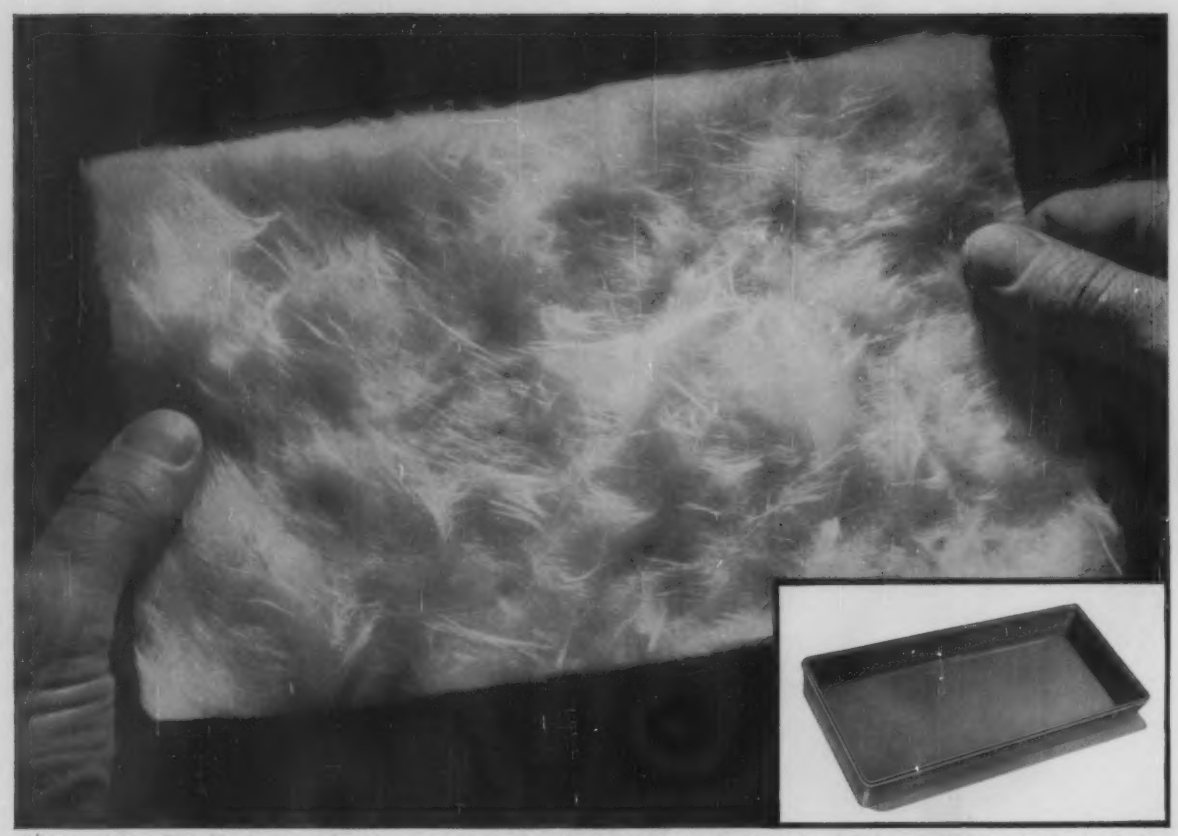

R/M Novabestos Glass Mat is the ideal reinforcement for use in such plastic products as containers, chemical-resistant tanks, hot air and liquid ducts, electrical insulators, boat hulls, honeycomb, decorative sheets, adhesive carriers, wood surfacing sheets and countless others.

WANTED: a low-cost material to withstand shock, protect delicate parts in materials handling applications

PROBLEM:

During fabrication, electronic components and guided missile parts must be handled in containers with smooth, relatively soft surfaces that will not mar or damage the delicate precision-machined parts. Yet the containers themselves must be strong, lightweight, shock resistant and reusable.

SOLUTION:

Tote boxes of plastic reinforced with R/M Novabestos Glass Mat No. 7415 were found ideal for the purpose. This material has exceptional uniformity in weight and glass fiber distribution. It wets readily with polyester, epoxy and other resins. It stretches without washing—permits ease in fabrication of smooth corners and edges. Surfaces are smooth and nonporous. Structures have uniform high physical properties. And superior weathering and decorative effects can be obtained.

R/M's OUTSTANDING LINE OF REINFORCED PLASTICS

If your design demands the following qualities, find out more about the new family of R/M reinforced plastics (felts, mats, papers and molding compounds).

1. *Excellent resistance to heat and flame*
2. *High modulus of elasticity from low to high temperatures*
3. *High strength from low to high temperatures*
4. *Smooth, abrasion-resistant surfaces*
5. *Exceptional dimensional stability*
6. *Elimination or reduction of surface crazing of resins*
7. *Good insulation and thermal properties*
8. *Economical to fabricate*

For further information, write for R/M Bulletin No. T-56

R/M

RAYBESTOS-MANHATTAN, INC.

ASBESTOS TEXTILE DIVISION, MANHEIM, PA.

FACTORIES: Manheim, Pa.; Bridgeport, Conn.; No. Charleston, S.C.; Passaic, N.J.; Neenah, Wis.; Crawfordsville, Ind.; Peterborough, Ontario, Canada

RAYBESTOS-MANHATTAN, INC., Asbestos Textiles • Laundry Pads and Covers • Engineered Plastics • Mechanical Packings • Sintered Metal Products • Industrial Rubber Rubber Covered Equipment • Brake Linings • Brake Blocks • Abrasive and Diamond Wheels • Clutch Facings • Industrial Adhesives • Bowling Balls

"Think this is something?...

you ought to see what you can do with

Plenco shell molding resins"

PLASTICS ENGINEERING COMPANY
Sheboygan, Wisconsin

We're not sticking our necks out when we say there can be definite economic and production advantages for you by shell molding with dependable, versatile Plenco resins. Many a foundry can vouch for that statement. Their profitable experiences with Plenco engineering and research are being repeated every day. Why don't you investigate?

Serving the plastics industry in the manufacture of high grade phenolic molding compounds, industrial resins and coating resins.

Strip away heat, light and staining problems ...stabilize plastisols and organosols with "Dutch Boy"

The "Dutch Boy" sees to it that the stabilization of plastisols and organosols is no problem today . . . despite the sensitivity of dispersion resins.

Take "clears"...

You have four "Dutch Boy" Stabilizers for clear plastisols and organosols.

"Dutch Boy" Provinite* handles high processing or service temperatures. A new, economical "Dutch Boy" barium-cadmium complex, Flomax*, stabilizes stocks where maximum clarity is demanded. Also promotes deaeration in plastisols. CS-137 provides *top notch* anti-oxidant action and light stability in organosols and vinyl solution coatings. The new "Dutch Boy" co-stabilizer, Nalzin*, prevents sulfide staining.

Take brightly colored and outdoor stocks...

"Dutch Boy" Dyphos® is the stabilizer to use. It's unequalled for heat stabilization during fusing cycles. Wonderful for awning cloths, convertible tops, outdoor toys, where maximum weather resistance is important.

Take translucent or highly plasticized stocks...

Try "Dutch Boy" Plumb-O-Sil® C. It gives minimum tinting and reactivity, excellent heat stability and economy. Promotes dry surfaces.

Take opaques, injection and slush molded...

"Dutch Boy" Tribase and DS-207® team up to improve molded stocks. The Tribase steps up heat stability. DS-207 aids mold release.

Get details and technical assistance on these "Dutch Boy" Chemicals . . . and on a new "Dutch Boy" Gelling Agent, BENTONE® 38 that controls flow properties and pigment suspension in these formulations. Write today for new "Dutch Boy" Stabilizer Handbook.

Dutch Boy® CHEMICALS

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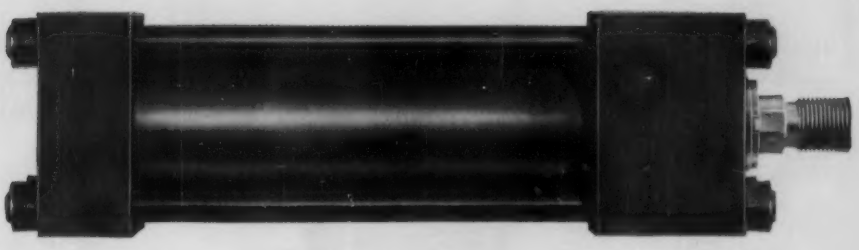


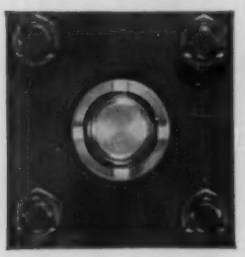
designed for leadership!

The superiority of Hannifin cylinders begins on the drawing board, where Hannifin designers have originated feature after feature not found in other air and hydraulic cylinders. But it doesn't end there.

Hannifin offers more kinds of cylinders, more sizes, more mounting styles. Each manufactured with such exacting control of dimensions and finishes that it not only looks like a better cylinder—its performance proves it!

As more and more discriminating specifiers and buyers are finding, the extra quality you get from Hannifin costs you no more, can usually be delivered sooner.

Why not specify Hannifin by name when you buy?

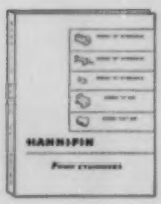


AIR AND HYDRAULIC

HANNIFIN

POWER CYLINDERS

Write for your copy of this new Hannifin Cylinder File—complete, easy-to-use, easy-to-order-from information on five lines of Hannifin cylinders. Hannifin Corporation, 553 South Wolf Road, Des Plaines, Illinois.



hercocel a® Two New Materials

Take your pick. Choose between Hercules Hi-fax, the new linear ethylene polymer, or this special new formulation of Hercocel A—either way you can be

HERCOCEL A (CA232)—Hercules' many years of experience in cellulose acetate has gone into the development of a new formulation for vacuum-forming. This new material provides excellent clarity, heats better, and is resistant to blushing, permitting economical processing, faster cycles, and less rejects. This may be just the plastic you need to upgrade an existing product by giving it increased sales appeal, longer shelf life.

HERCOCEL A MEETS A NEED—When Chanal Plastics was seeking a material for vacuum-formed plastic "blisters" to be shaped to the contour of white rubber basin and bath stoppers, they selected the new formulation of Hercocel A. Good clarity was a "must" for this combination cardboard-acetate package. Hercocel supplies it along with all the processing advantages that make for a low-cost production cycle. Complete package units are quickly assembled.

HERCOCEL INCREASES SALES APPEAL—By forming "blister" to contour of product, visibility is increased on the counter and product is protected from soiling and other damage. The product actually supports plastic protective cover, eliminating possibility of "blister" being dented in transport or handling.

Vacuum-formed by Chanal Plastics Corporation
361 Stagg Street, Brooklyn 6, New York

For Vacuum-Forming ⟩ hi-fax®

sure of getting a plastic material with "just right" characteristics for your own vacuum-forming needs.

HI-FAX—This new linear ethylene polymer offers you a combination of properties for vacuum-forming never before available in a low-cost plastic. Here's what Hi-fax sheeting for vacuum-forming offers:

- **RIGIDITY AND TOUGHNESS IN LARGE SECTIONS**
- **TEMPERATURE RESISTANCE —CAN BE STERILIZED**
- **EXCELLENT REPRODUCIBILITY**
- **IMPACT STRENGTH AT LOW TEMPERATURES**
- **IMPROVED FINISH**
- **TRANSLUCENCY IN A WIDE COLOR RANGE**
- **GOOD ELECTRICAL PROPERTIES**
- **CHEMICAL RESISTANCE**
- **LOW MOISTURE PERMEABILITY**

Now available for commercial production runs, this new Hercules material is already the talk of the plastics industry!

BIGGER AND MANY WAYS BETTER—The four-cavity toy package and a light diffuser panel shown here were both vacuum-formed with Hi-fax sheeting manufactured by Gering Products, Inc., Kenilworth, New Jersey. Light diffuser was manufactured by Tiger Plastics, Brooklyn, New York; Toy package by Vacuum Molding, Inc., Boonton, New Jersey.

HERCULES

Cellulose Products Department

HERCULES POWDER COMPANY

INCORPORATED

916 Market St., Wilmington 99, Del.

See why customers prefer soft goods wrapped in glass-clear films made from Spencer's new exclusive 2400 series polyethylene.

Are You Using This *New* CLEARER Polyethylene?

Exclusive new Spencer film grade resin is also stiffer and easier to handle, yet costs nothing extra:

Extruders are now switching to a new, glass-clear film produced from the exclusive "Poly-Eth" 2400 series resins. And they report that by actual comparison, this film is twice as clear as conventional polyethylene film, and it has a higher gloss.

This means greater package beauty than has ever before been possible for soft goods wrapped in polyethylene film. It means no color dulling due to semi-opaque film. Every color, every line is as sharp and clear as though you were looking at it through a window.

The film is stiffer, too! Test it yourself—twist it, crumple it in your fingers. You'll find that film made from a "Poly-Eth" 2400 series resin is the stiffest standard film you can buy today!

Also, it's easier to feed this film into bag machines. And, because of its extra stiffness, it's easier to stack the finished bags. Excellent runs have been processed at 0.4 mil thickness with both blown and flat film.

You get faster filling when you use this film, because it opens so much more easily. Test it with your fingers. Discover for yourself how free it is from tack and clamminess. And because it is less permeable, it is extra suitable for laminating.

Tailored to your needs, this new "Poly-Eth" 2400 series resin comes in three different compounds: 2405 has no slip, 2425 has medium slip, and 2455 has high slip.

This is the answer to a packager's dreams: the durability of regular polyethylene combined with *extra* stiffness, plus *glass-like* clarity. Yet a "Poly-Eth" 2400 series resin costs no more than regular polyethylene! If you're interested in film for soft goods, textiles, candy, or bakery goods, find out more about this newest forward development in packaging.

Write today to Spencer Chemical Company, creators of these exclusive new "Poly-Eth" film resins. We'll be glad to send you full details without obligation. Just drop a line to Spencer Chemical Company, Dwight Bldg., Kansas City 5, Missouri.

SPENCER CHEMICAL COMPANY
Dwight Bldg., Kansas City 5, Mo.

Test it yourself on any surface . . . for

SUPERIOR ADHESION

OUTSTANDING BRILLIANCE

SHARP, CLEAN CUTTING

New GRAUERT #750

imitation gold for

HOT DIE STAMPING of exceptional quality

PLASTIC PRODUCTS AND PACKAGING sparkle with new luster and sales appeal when they're stamped with Grauert's new #750 Imitation Gold—a truly superior stamping leaf for clean, brilliant, lasting impressions. Made of highly refined bronze powders mounted on supple plastic film, Grauert's #750 is perfectly engineered for stamping on all plastics, rigid as well as flexible, as well as on imitation leather, etc.
TEST IT YOURSELF—on your products, and see the superior results. For additional information, samples, prices and specifications, please call or write

GRAUERT STAMPING LEAF IN GENUINE GOLD, BRONZE, ALUMINUM AND COLORS

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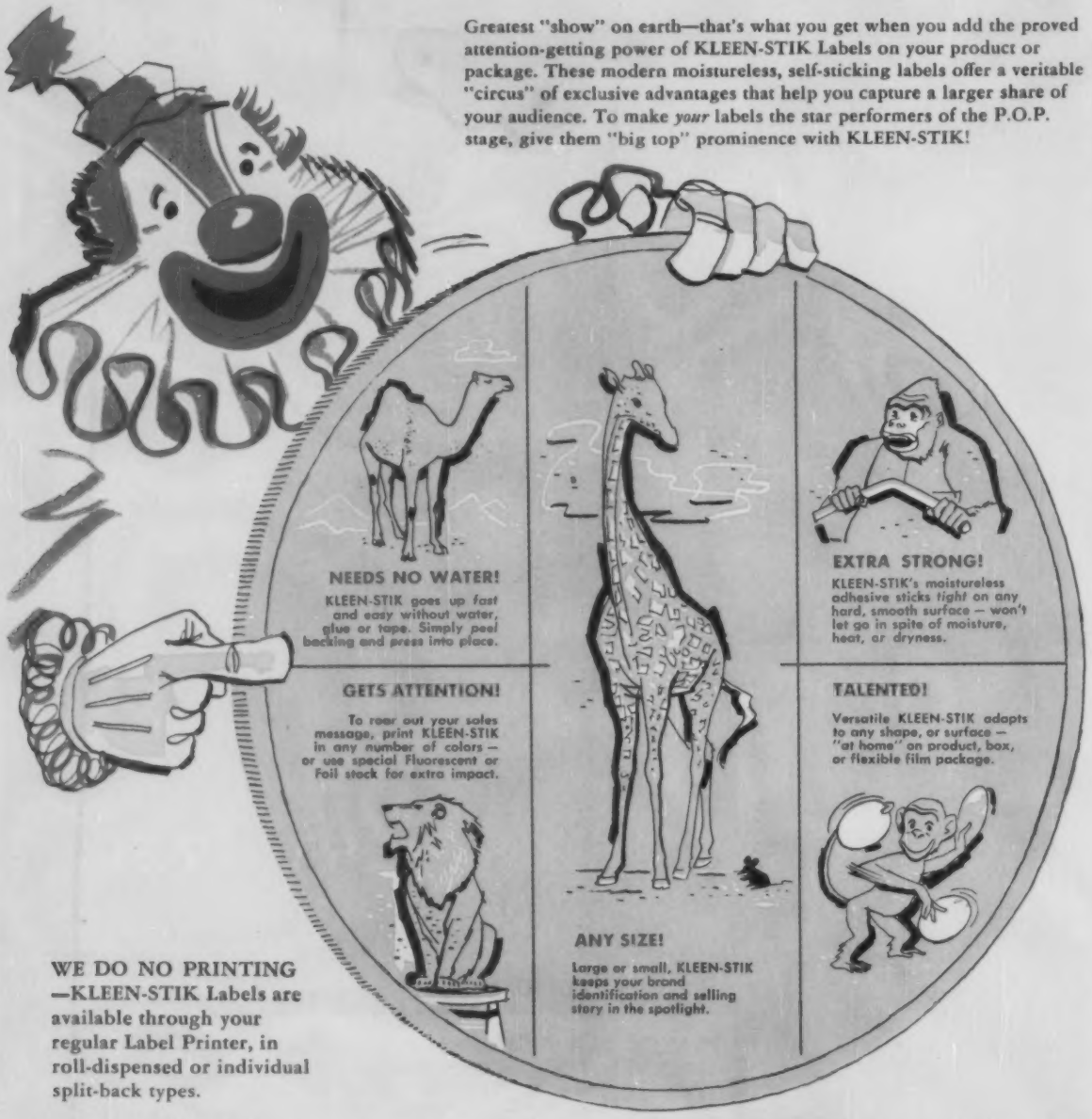
100 GOLD ST., N. Y. 38, N.Y. BARCLAY 7-8267
QUALITY STAMPING LEAF FOR EVERY PURPOSE

KLEEN-STIK® Labels

put your Product in the Center Ring of Selling!

Greatest "show" on earth—that's what you get when you add the proved attention-getting power of KLEEN-STIK Labels on your product or package. These modern moistureless, self-sticking labels offer a veritable "circus" of exclusive advantages that help you capture a larger share of your audience. To make *your* labels the star performers of the P.O.P. stage, give them "big top" prominence with KLEEN-STIK!



NEEDS NO WATER!
KLEEN-STIK goes up *fast* and easy without water, glue or tape. Simply peel backing and press into place.

EXTRA STRONG!
KLEEN-STIK's moistureless adhesive sticks *tight* on any hard, smooth surface — won't let go in spite of moisture, heat, or dryness.

GETS ATTENTION!
To roar out your sales message, print KLEEN-STIK in any number of colors — or use special Fluorescent or Foil stock for extra impact.

TALENTED!
Versatile KLEEN-STIK adapts to any shape, or surface — "at home" on product, box, or flexible film package.

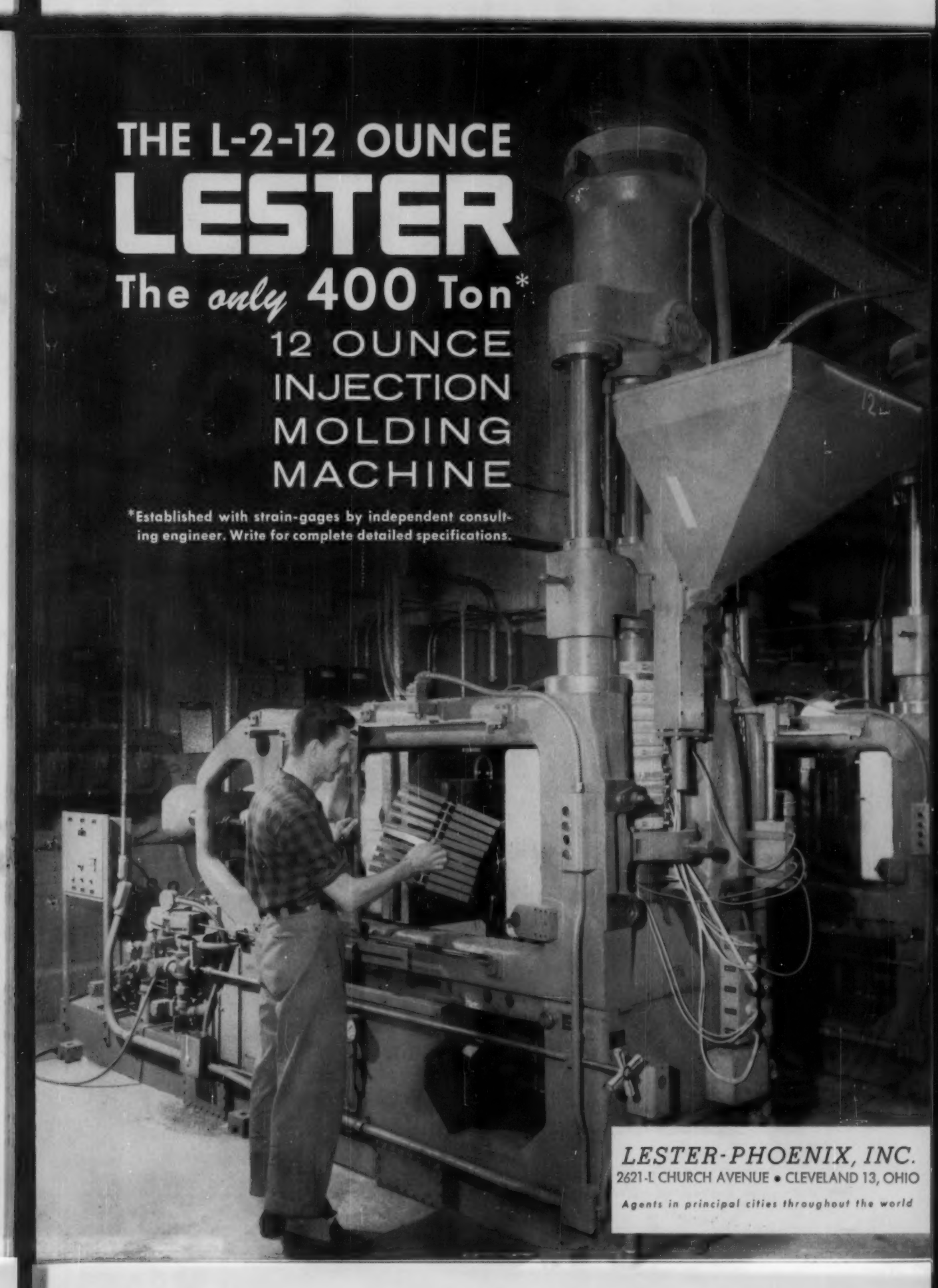
ANY SIZE!
Large or small, KLEEN-STIK keeps your brand identification and selling story in the spotlight.

WE DO NO PRINTING —KLEEN-STIK Labels are available through your regular Label Printer, in roll-dispensed or individual split-back types.

PRODUCT AND PACKAGE LABELS | NAMEPLATE LABELS | INSTRUCTION LABELS | CAUTION LABELS | PRICE MARKER LABELS

KLEEN-STIK Products, Inc.
7300 WEST WILSON AVENUE • CHICAGO 31, ILLINOIS
Pioneers in Pressure-Sensitives for Advertising and Labeling

See how leading manufacturers are using efficient, economical KLEEN-STIK Labels—write on your letterhead for free samples!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The only 400 Ton*
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*Established with strain-gages by independent consulting engineer. Write for complete detailed specifications.
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2621-L CHURCH AVENUE • CLEVELAND 13, OHIO
Agents in principal cities throughout the world

complete compatibility

ARGUS Drapex plasticizers and Mark stabilizers have overcome annoying and time-consuming production problems for manufacturers of vinyl rain boots.

Because Argus products bring about complete compatibility among the ingredients in the mix, these boots are now being produced speedily in quantity. Costly delays caused by lack of heat stability in the plastisol, mold plate-out, and air bubbles trapped in the mix have been done away with. And manufacturers have increased their sales and profits with a quality product that has low temperature flexibility, greater weatherability, and is more durable.

Whatever your vinyl formulation problems, *Argus has the answer*—either in "line" products or in our research laboratory. Let us help *you*, too, to speedier production, better end-products and bigger profits. Write for technical bulletins and samples.

ARGUS CHEMICAL CORPORATION / New York and Cleveland

Main Office: 633 Court Street, Brooklyn 31, N. Y. Branch: Frederick Building, Cleveland 15, Ohio

Rep's.: H. M. Royal, Inc., 4814 Loma Vista Ave., Los Angeles; Philipp Bros. Chemicals, Inc., 10 High St., Boston; H. L. Blachford, Ltd., 977 Aqueduct St., Montreal.

breaking the cost barrier!

A NEW CAMERON IS NOW AVAILABLE TO CUT YOUR PRODUCTION COSTS

DOWN,

DOWN,

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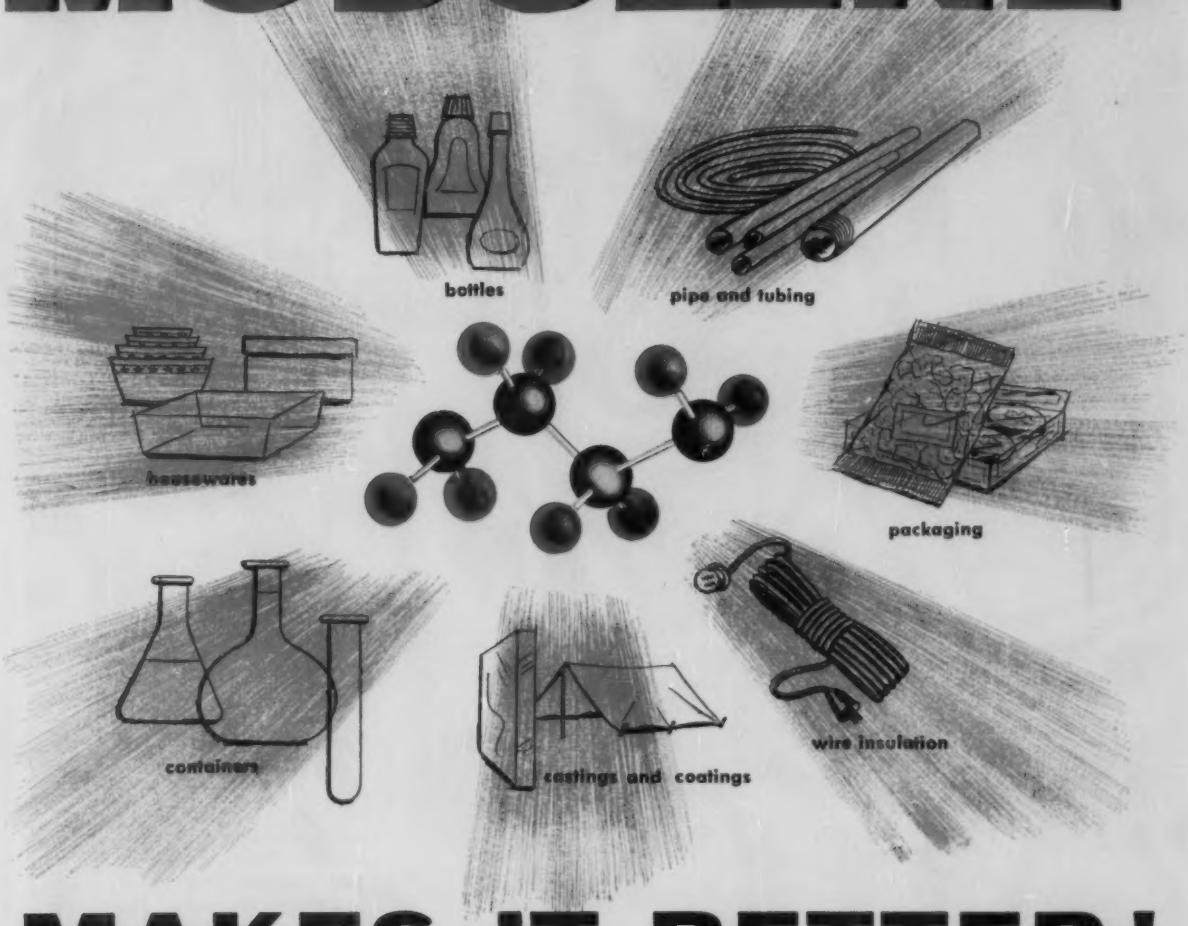

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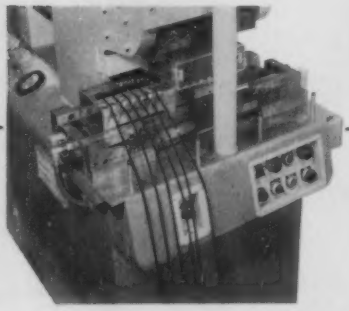

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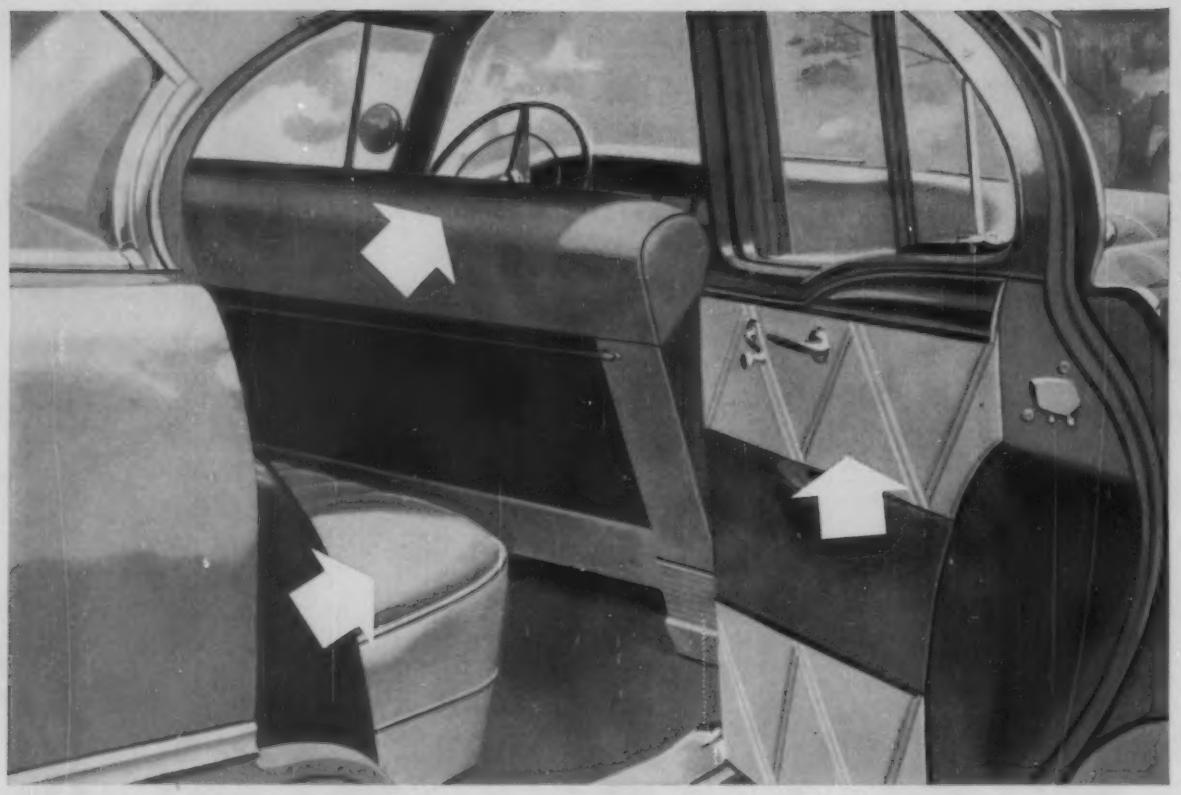

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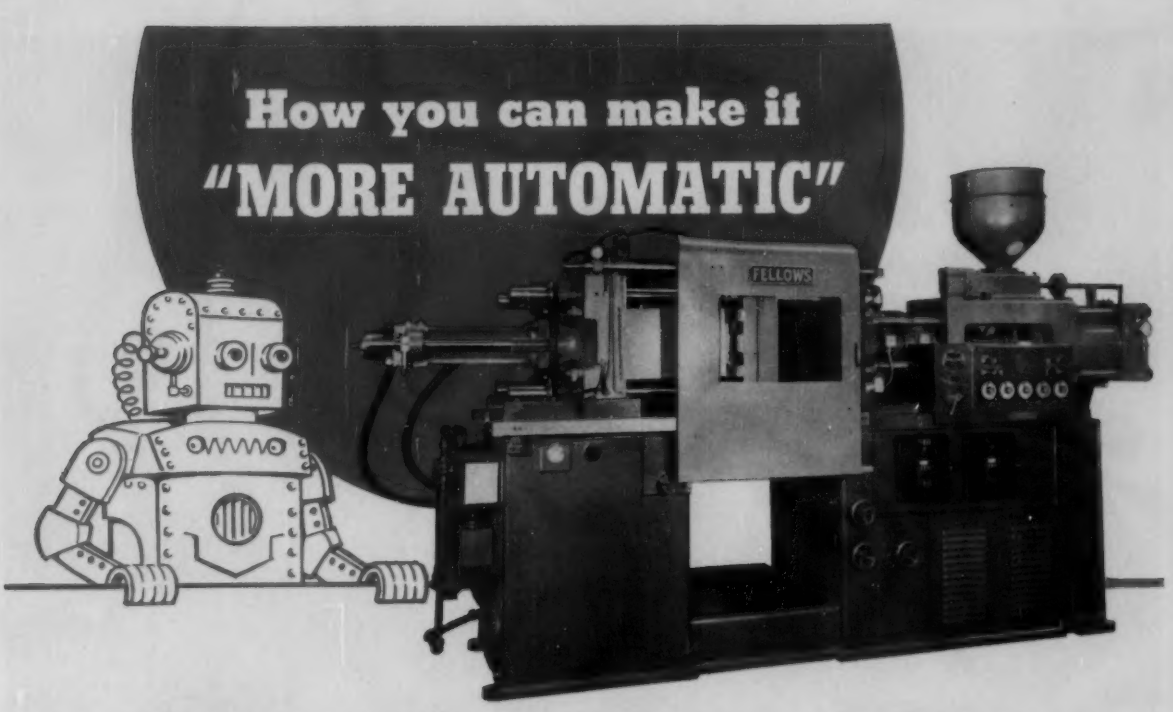

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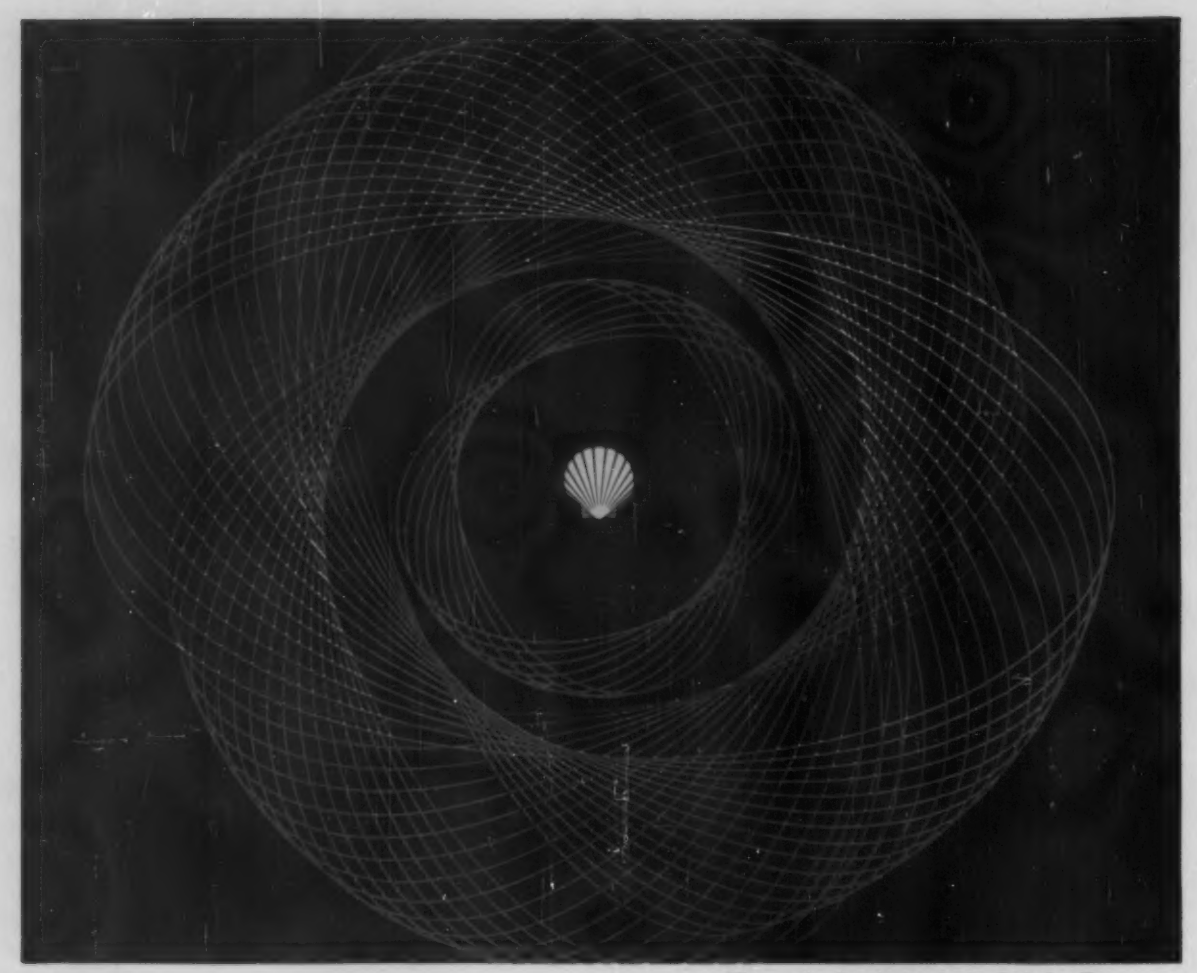

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SHELL

The Plastiscope*

May 1957

News and interpretations of the news

By R. L. Van Boskirk

Section 1

Minnesota Mining & Manufacturing Co. takes over Kel-F. Purchase of M. W. Kellogg's fluorocarbon (Kel-F) plant in Jersey City by 3M seems like a "natural" for 3M. It is also an indication that executives of Pullman Co., parent of Kellogg, don't think they belong in chemicals.

Kellogg's license from Phillips to produce polyolefins was not mentioned in the announcement of the sale. A site had been chosen near the Phillips ethylene plant in Texas, but that seems to be about as far as the program had progressed. Kel-F production sagged some time ago when a big military application was changed over to another plastic and civilian uses have had to be built up slowly on fairly small volume applications. Among the many civilian uses of Kel-F, aside from various electrical parts, are sutures and vials that have to withstand dry sterilization and resistor sleeves for computers.

Kel-F is more costly than Teflon, the other chief fluorocarbon, and its properties are somewhat lower due to the presence of chlorine, but it can be injection molded. Kel-F capacity was at one time rated at about one million pounds. Teflon production last year was rated by one market analyst at approximately five million pounds. Fluorothene, the Bakelite product similar to Kel-F, is still being offered by that company.

For some years 3M has owned a fluorocarbon production process which is different than that of either Du Pont or Kellogg but has never marketed its product—at least not in public. However, 3M uses fluorocarbons in some of its tapes and has released considerable publicity concerning its fibrous glass-reinforced fluorocarbon pipe which is highly resistant to corrosion. Company spokesmen say their primary interest in Kel-F is to develop additional uses, particularly within the chemical and pharmaceutical fields.

General Electric's new polycarbonate. Lexan, G-E's recently announced resin, introduces an interesting new material to the plastics family. It is described as having some thermosetting properties in a thermoplastic product. It is primarily intended for injection molding but can be compression molded, although the latter production process is not recommended. It can also be extruded or cast into film or extruded over wire.

The heat distortion point of the new resin is close to 290° F. either at a normal load of 66 p.s.i. or heavy load of 264 p.s.i. The heat distortion point of nylon is over 300° F. at 66 p.s.i. but drops to less than 100° F. at 264 p.s.i. Lexan has been aged for 1000 hr. at 125° C. without undergoing any important change in properties.

Lexan is hard but so tough that a small test bar can be twisted into a spiral and then untwisted without breaking. A startling demonstration made

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SHEETS RODS TUBES SLUGS	DOW	POLYSTYRENE

The Plastiscope

(*Continued from p. 41*)

by G-E is to sharpen the end of a nail-sized rod of Lexan with a pencil sharpener to show how easily it can be machined and then drive the sharpened nail-shaped rod into a piece of wood with a hammer. Strips of Lexan can be bent double many times without breaking.

The material is being suggested for coil forms, electronic structural and insulating components, gears, auto lenses on dome lights, and hardware on equipment where its high impact and heat resistance can be put to good use in replacing metal.

Lexan is presently available in only small pilot plant quantities of a few pounds per week. G-E is using present production to evaluate its applicability for suggested applications and make that information available to the trade. Introductory price will be $2.50/lb. when there is enough available for general distribution. Eventually, it is expected to reach the nylon price level. Large-scale commercial production is not expected before 1960.

Borden acquires another processing plant. The Lawrence Process Company, Inc., North Andover, Mass., has been acquired by Borden's Chemical Div. and will be operated as a subsidiary. Among the company's extruded products are plastic shoe welting, heel bases, garden hose, printing plates, and plastics compounds. The company employs about 130 workers.

Borden now has extrusion plants on both the East and West Coasts. Resin Industries, Santa Barbara, Calif., acquired last year, is now known as the Resinite Dept. of Borden and is managed by Grant C. Ehrlich, former owner. Lawrence was founded in 1952 by E. F. Hogan, president, and his brother, Daniel E. Hogan, Jr., assistant treasurer and formerly with Bolta.

Polystyrene for thin-walled products. A new Bakelite polystyrene compound, SMD-3700, has been developed for thin-wall sections such as those in disposable cups and delicatessen or ice cream containers. During test shipments the percentage of breakage of SMD-3700 containers was less than half that of containers molded from general-purpose polystyrene.

The new material flows within mold cavities at lower cylinder temperatures and pressures than g.p. polystyrene and the products are less permeable to air, oxygen, nitrogen, and moisture vapor.

Polyethylene for polyethylene. The appearance of a Semet-Solvay Petrochemical Div. booth at the California plastics show was a significant indication that the company's low-molecular-weight AC polyethylene has really arrived as a helpful additive for standard polyethylene. It is reported that more AC polyethylene is being sold for such use by injection molders than for any other purpose, including paper coating, ink, or polish. It is claimed that when AC polyethylene is properly blended in quantities of from 5 to 30% with either standard or low-pressure-processed polyethylene, the molder can use a low melt index polyethylene and get better gloss and color dispersion than he can get with a high melt index polyethylene, and with no loss in stiffness.

AC polyethylene is also claimed to have been a key factor in obtaining true color dispersions for film. Still another most promising use is its

REZ-N-KLEEN
for cleaning acrylics

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for cleaning polystyrene

REZ-N-POLISH
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The Plastiscope

(*Continued from p.* 43)

adaptability in a blend with other polyethylene for slush molding. By using AC to make polyethylene easier flowing, molders can switch from other materials which use solvents.

The price for AC is 30¢ a pound. That price has been stable since January 1955 and promises to remain so for an indefinite period.

Aries low-pressure type polyethylene. R. S. Aries and Assoc. has been quietly working on a "different" low-pressure type polyethylene that is now ready for commercial exploitation. It is a joint European and American development worked out from various research projects. About eight tons have been produced in several pilot plants. Aries does not expect to produce commercial quantities itself, but its process is available for licensing; two or three companies are reported as signed up already.

Aries states that its material is conspicuous for a tight control of molecular weight (from 70,000 to 90,000) which, among other things, will help control environmental stress cracking, an often troublesome feature in other polyethylenes. Other important factors claimed are good color and a simple, low-cost catalyst which is not flammable in air, does not need to be regenerated, and can be easily removed.

Some of the properties are: density when annealed, 0.960—cold pressed, 0.965; melting point, 131 to 132° C.; tensile strength at 25° C., 4000 to 4500 p.s.i.; crystallinity, 95%; heat distortion point, 80° C.; dielectric constant (50 mc at 25° C.) 2.38.

European polyethylene production. The biggest expansion in the European plastics industry is in polyethylene, according to a paper read by Miles A. Dahlen of Du Pont at the Chemical Market Research Association meeting devoted to foreign chemicals. His paper stated that there are now in operation three plants in Germany and one each in the U.K., France, and Italy. Within the next two years there will be ten more—four in France, three in Germany, two in the U.K., and one in Holland.

The paper pointed out that there would seem to be little economic basis for a program by foreign producers to seek outlets for their polyethylene in the U.S., but on the other hand their economics of plant operation may make this prediction inaccurate if European markets fail to develop rapidly enough to absorb their output.

Beware of slide rules and percentages. This observer has been carrying on a friendly feud for several years with analysts who try to measure the plastics industry with percentages and slide rules. It is our contention that most of the industry is still too young for that kind of measurement. This opinion seems to have been at least partially supported by V. P. Elwyn E. Winne of W. R. Grace & Co., Polymer Chemicals Div., at the same CMRA meeting mentioned above. Said Mr. Winne when talking about the problems of market analyses for U. S. chemicals and plastics in foreign lands: "statistical generalizations are dangerous."

He pointed out that citing per capita consumption of a product in

DYLITE® expandable polystyrene insulates 20,000-foot air-conditioning line

By mid 1957, a 20,000-foot underground chilled-water line will be at work helping to air condition The Port of New York Authority's $120,000,000 "Terminal City" at New York International Airport. The entire line will be insulated with DYLITE plastic, the original expandable polystyrene.

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There were excellent reasons in choosing DYLITE for this job. First, DYLITE is a highly effective insulating material. Its moldability means that it can be foamed in a mold or extruded *to exact specifications*—thus saving fabrication costs. DYLITE is lightweight for easy handling. Installation is a simple matter of slipping two half-round sections over the coated pipe, then wiring them in place.

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In some locations, the DYLITE protected line will *actually be under water!* Here, DYLITE again makes the ideal insulating material because of its low rate of absorption.

Mundet Cork Corporation of North Bergen, N. J., molder and installer of the DYLITE insulation on this job, says . . . "Based on our experience on the New York International Airport project, there is every indication that DYLITE's properties and advantages will find more widespread use for this type application."

Have *you* thought of taking advantage of DYLITE's properties in your business? If you have need of a material with low K factor, strength, low water absorption, easily molded or extruded and yet competitively priced, investigate DYLITE expandable polystyrene. For more information, write Koppers Company, Inc., Chemical Div., Dept. MP-57, Pittsburgh 19, Pa.

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The Plastiscope

(*Continued from p. 45*)

Brazil, for example, is far different than in the U. S. because less than half of Brazil's population is "economic population." He pointed out that foreign markets are generally more volatile, have smaller base points and different economic problems generally. He also told why uneconomic, high-cost production of chemicals in a foreign country might be better for the country than if they were imported at lower cost. Mr. Winne's paper is must reading for anyone studying foreign trade in chemicals or plastics.

Petrochemicals notes for plastics. Cosden Petroleum Corp. has dedicated its Big Spring, Texas, plant for production of 20 million lb. of styrene monomer annually. Its styrene is made directly from ethylbenzene, taken right out of the petroleum stream. This eliminates the step taken by other companies of combining benzene and alcohol. Cosden claims purity is high enough to qualify for plastic-grade styrene.

Phillips Chemical Co.'s Marlex 50 polyethylene plant is now on large-scale production—will reach a 75 million-lb. annual rate soon.

Vickers Petroleum Co., Potwin, Kans., claims to be first petrochemical plant in Kansas. It will be a Udex construction unit and will produce such chemicals for plastics as benzene, toluene, and xylene.

Oronite Chemical Co., a subsidiary of Standard Oil Co. of California, is proud of a new polyester resin incorporating its isophthalic which the firm believes gives "epoxy properties with polyester costs." It is claimed that when isophthalic is used in a polyester, it can be diluted with 10 to 15% more styrene than when using phthalic anhydride and still retain the same strength properties. Thus the 3¢ higher price differential for iso is wiped out. The new polyester, made by Chemical Process Co., Redwood City, Calif., is named Dion Isophthalic resin. A boat made from it, claimed to be half again as tough as others, is by Dorsett Plastics Corp., Santa Clara, Calif.

Richfield Oil Co. is to build a 16 million-gal.-a-year benzene plant at Watson, Calif. This is Richfield's first petrochemical venture. Guessing was that its first effort would be phthalic anhydride. Other companies, too, are re-evaluating the phthalic situation. Reasons are: possible over-expansion and last year's decline in alkyds which use great quantities; other competitive materials are also around.

Passing of the haymow? Almost every man who was raised in an agricultural environment will have nostalgic pains when he hears that plastics film may eventually obsolete the old time haymow, that popular rendezvous during playtime hours down on the farm. Black 6-mil polyethylene film is now being promoted by Visking as the successor to the haymow, to be used in horizontal and trench silos for storage of green forage. A Purdue University report quoted by Visking states that plastic silos may be built with a minimum of labor and located at sites convenient for both making and feeding the silage. Capacity of silos may range from a few tons to over 100 tons. It is reported that ¼ million lb. of polyethylene film is now in experimental use. It is possible that two million lb. will be used within a year and growth could be fast after that.

For additional and more detailed news see Section 2, starting on p. 250

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WE HAVE A HOUSE to put in order . . . and it's the house where America lives.

Of our country's many million homes, more than 1 out of every 10 are out-and-out slums. Nearly one-half of all American dwellings are in poor to "fair" condition, and urgently need basic repairs.

Something *must* be done—both to correct the slums of today and *prevent* the slums of tomorrow.

How do slums start? Usually just one house starts to slide downhill and soon a whole block changes. Pride is lost. Other houses are neglected, decay spreads.

So the 20 million homes in need of basic repair and improvements deserve equal attention. The time to stop the spreading blight of slums is *before it starts*.

What's your stake in stopping slums?

If you think your town is different, just look around you . . . If you think slums only affect persons who live in them, think again.

Slums raise taxes and lower property values of the whole town. They raise rates of crime, delinquency and disease. *Everyone* has a real stake in stopping slums. And *that includes you as a businessman*.

Your firm is certainly dependent on the welfare of the community where you do business. But it's more than good business—it's good citizenship to take part in efforts aimed at civic improvements. It's the *responsibility* of every business.

What can your firm do? The answer to America's housing problems starts with individuals. But to roll back slums is such a big job it's going to take more than individual effort. It will need the cooperation of your business and many others.

Some slums should be torn down and a fresh start made. Others can be remodeled and made to conform to better living standards. So it is up to you to support every sound program which seeks adequate housing for all our people.

New help is now available

There is a new national, non-profit organization called A.C.T.I.O.N.—The American Council To Improve Our Neighborhoods—which is designed to help all individuals or groups interested in putting America's house in order.

Send for a free copy of "ACTION." It explains what A.C.T.I.O.N. is and proposes to do. It lists booklets, research, check-lists, and other material which can help you. Address P. O. Box 500, Radio City Station, New York 20, N. Y.

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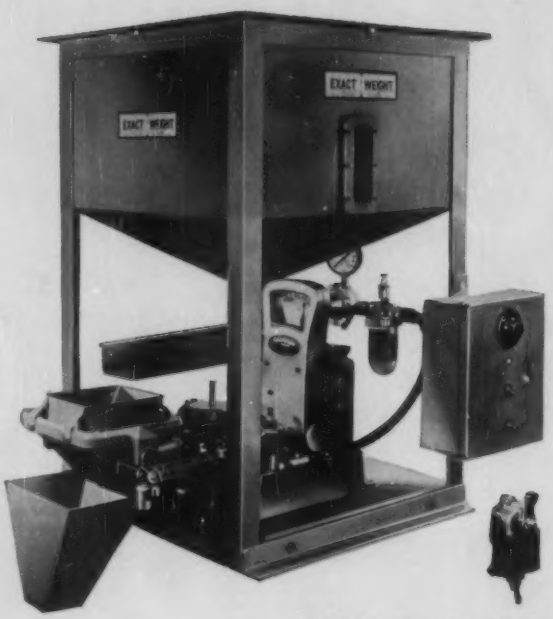
for injection molding

With approximately one thousand Exact Weight Precision Weighing Machines in use throughout the industry, leading molders report savings on material, elimination or reduction of rejects, faster molding cycle and improved quality of molded parts.

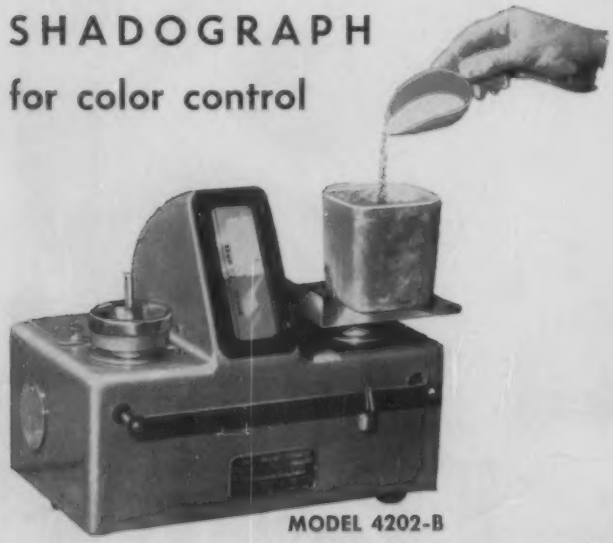
Operation of the Weighing Machine is fully automatic. The new Automatic Plunger Position Control is effective in either starve or cushion feeding with visible weight indication on every charge.

The 1:1 ratio lever system, in a complete precision scale with over-under indication, provides extreme accuracy. Double controls cut off feed to scale following all vibration in the press—no material shakes from feeder pan following cut-off. Air-operated weight bucket eliminates all impact to scale. Fine adjustments, 1/100 oz. or 1/4 gram increments, can be easily made. (Avoirdupois or metric system optional at no extra cost.)



MODEL 610-F-00-IM-2

SHADOGRAPH
for color control



MODEL 4202-B

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These scientific cost and quality control instruments are backed by more than 40 years of industrial scale building experience. Write for complete information.

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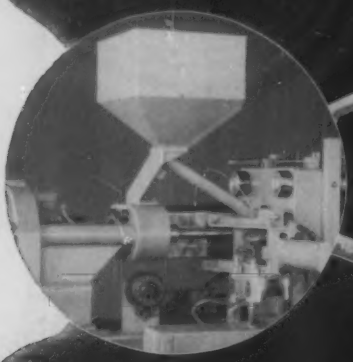

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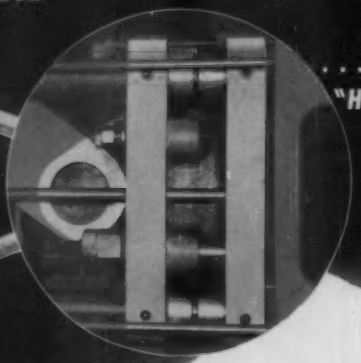

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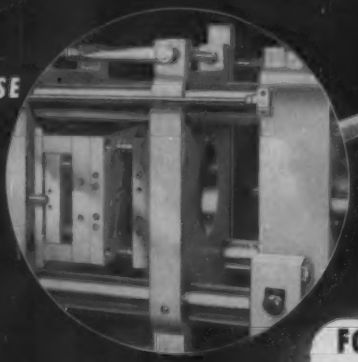

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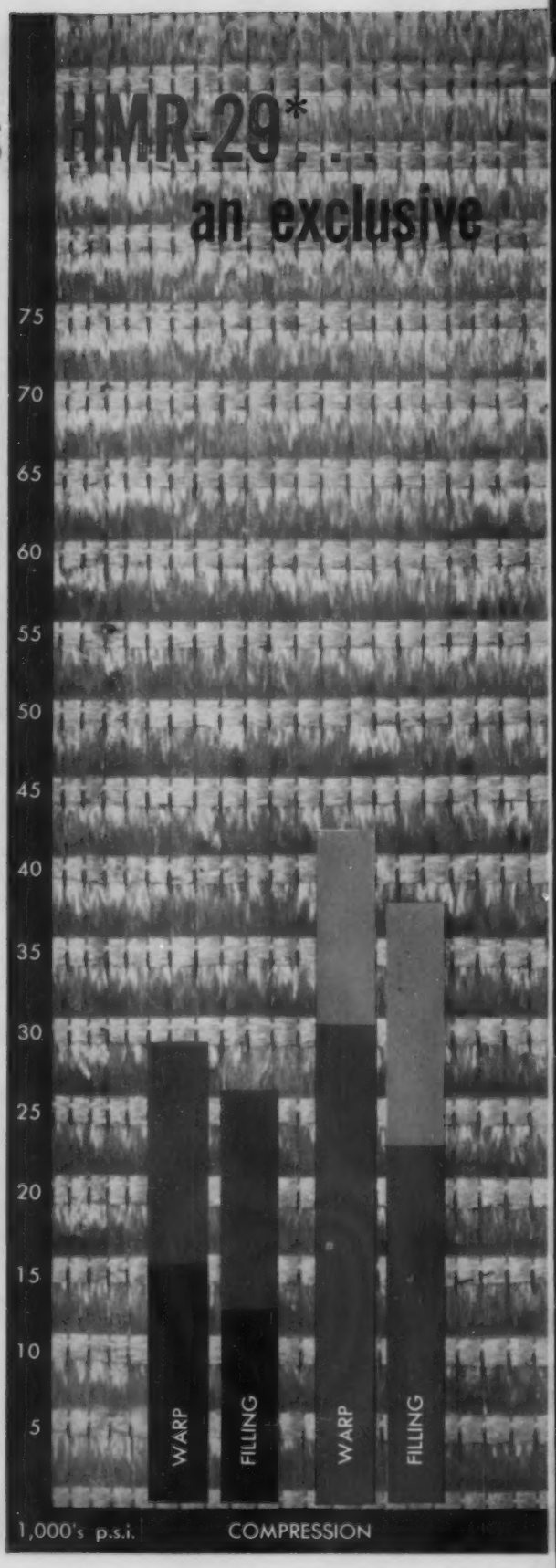

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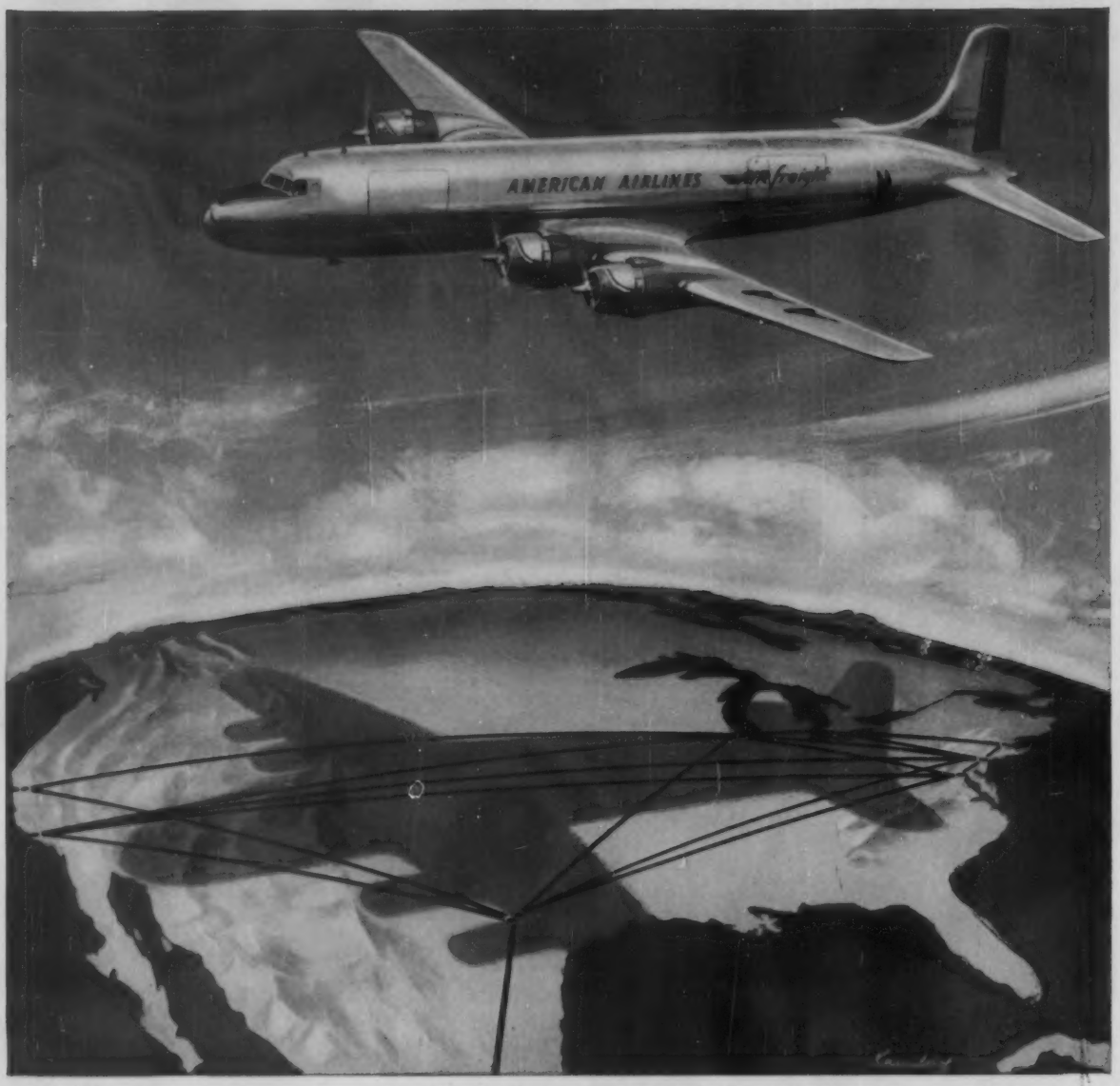

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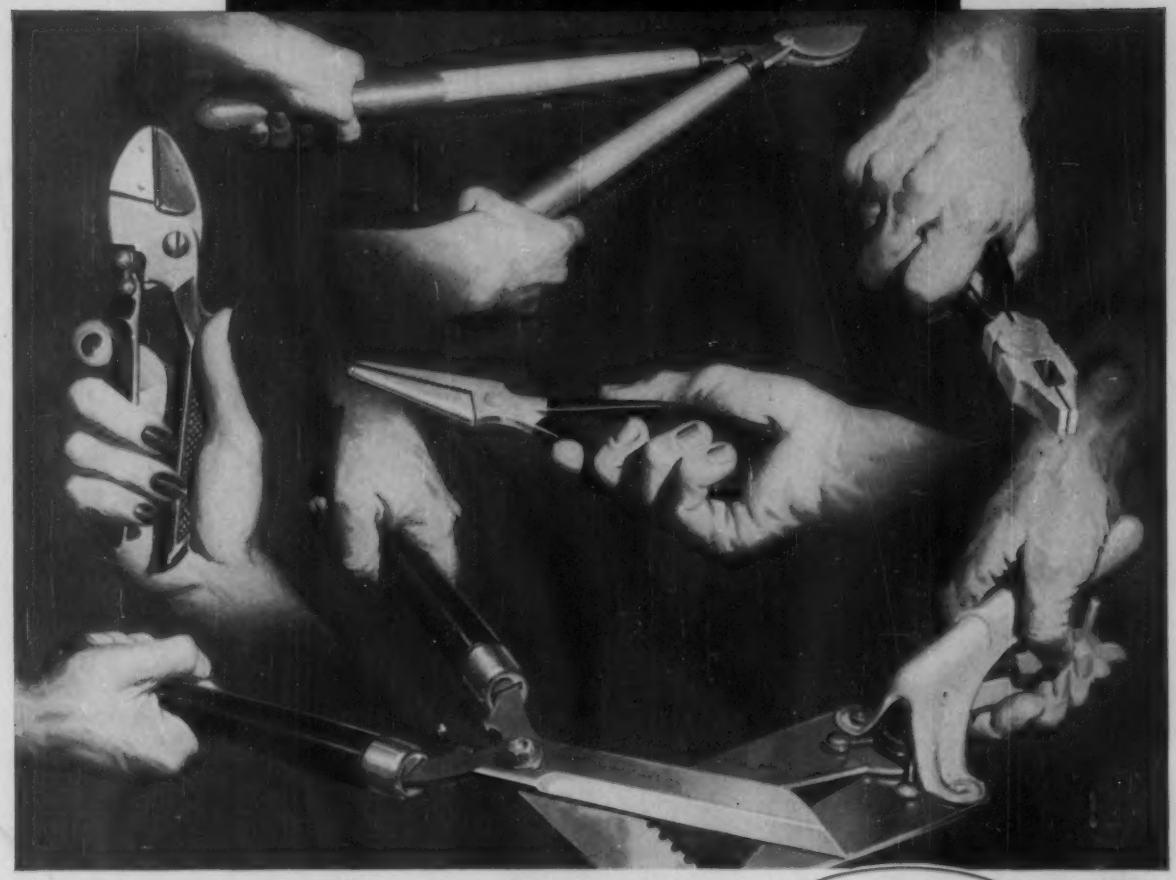

EXON 654 ... specifically for protective dip-coating

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Tool makers have discovered that EXON 654 resin improves products three ways.

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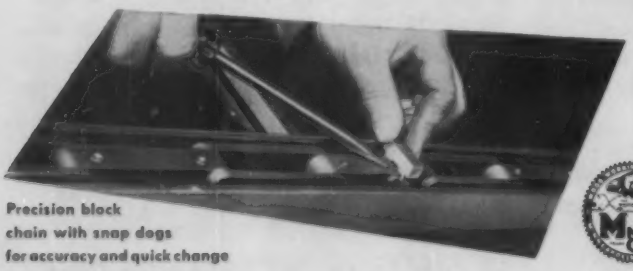

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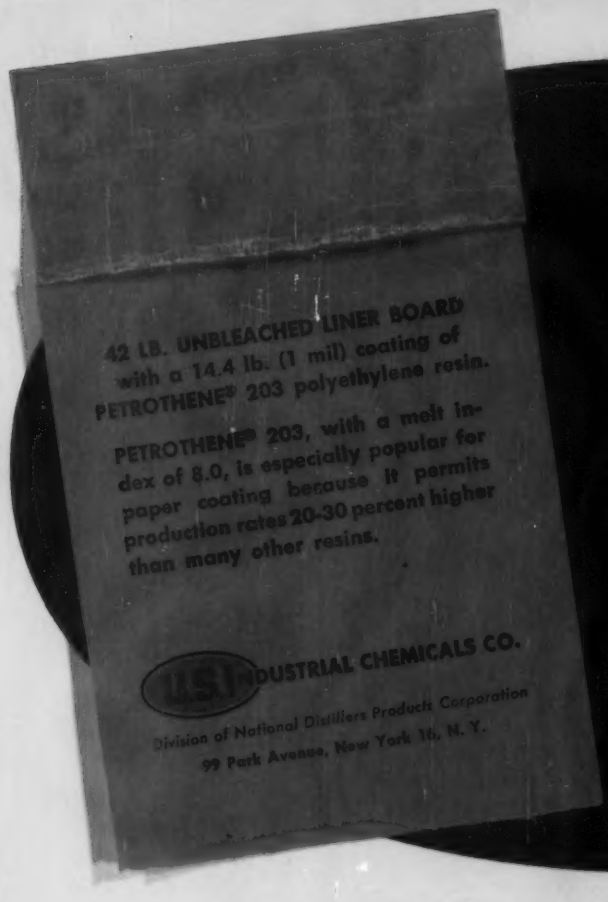
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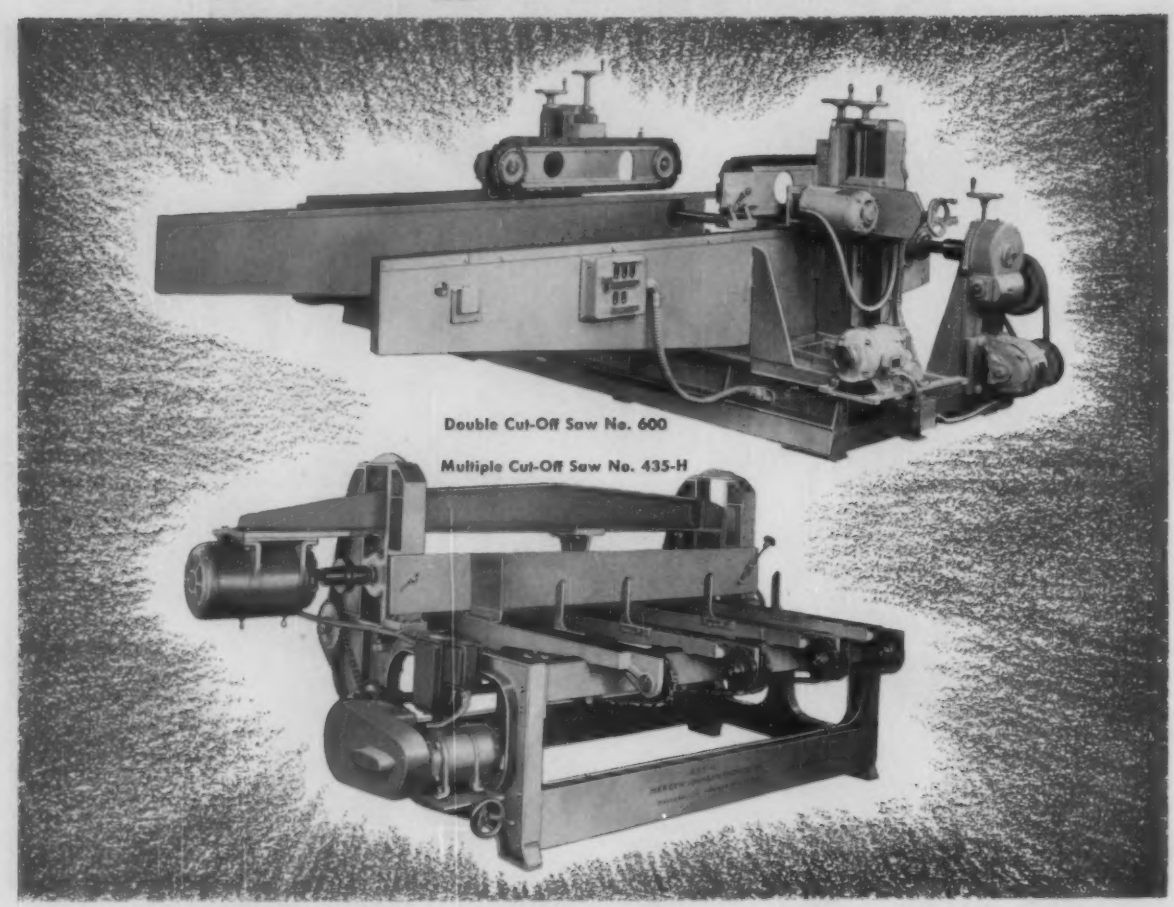

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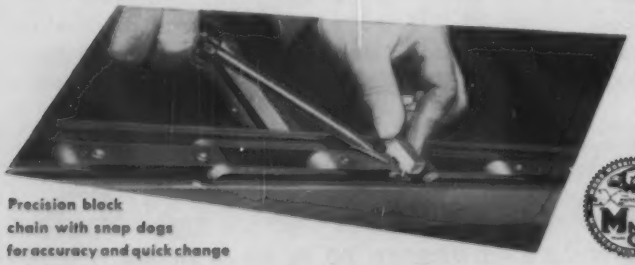

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Petrothene paper coating resins have these advantages over many other polyethylenes . . .

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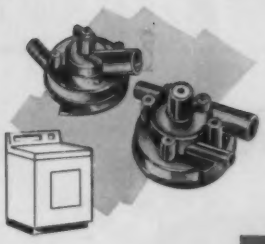

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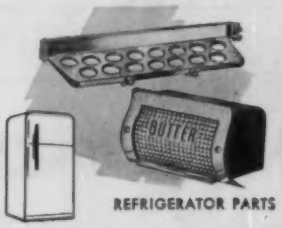

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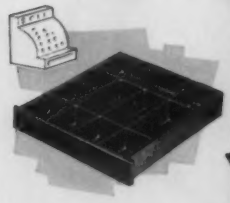

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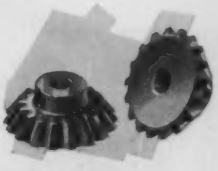

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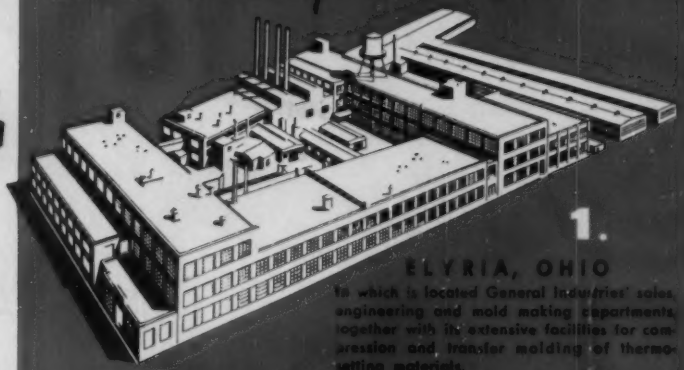

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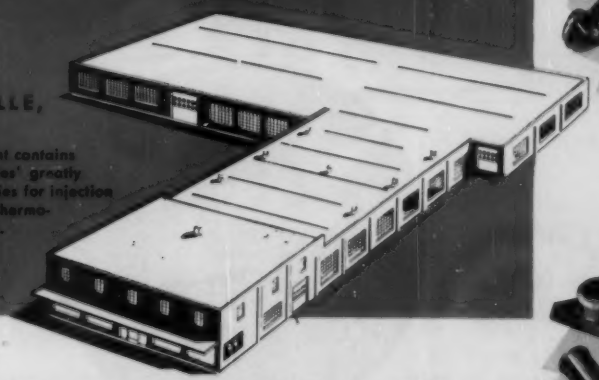
This modern plant contains General Industries' greatly expanded facilities for injection molding of all thermoplastic materials.



...it pays to RELY on GI!

- **COMPLETE ENGINEERING SERVICE**
- **COMPRESSION MOLDING** 150 presses ranging up to 1850 ton capacity.
- **INJECTION MOLDING** 17 presses ranging up to 200 oz. capacity.
- **FINISHING EQUIPMENT** Automatic facilities include equipment for trimming, polishing, buffing, drilling, tapping, tumbling and painting.
- **MOLD MAKING FACILITIES** General Industries' own tool and die shop is capable of producing all types of high quality custom molds and dies.

THE GENERAL INDUSTRIES CO.

PLASTIC DIVISION • ELYRIA, OHIO

For Plastics – go to Worbla

Manufacturers of plastics for over thirty years.

WORBLA-PLASTICS have proved their worth

So that you may see for yourself — we shall gladly provide you with samples.

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Celluloid in sheets, tubes and rods.

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Acetate powder for injection molding and extrusion.

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ALL THE ADVANTAGES OF INTEGRAL VALVING WITH EITHER 8 or 115 VOLT BUILT-IN CONTROLS

The Bellows Air Motor with the built-in 8-volt directional valve revolutionized the use of pneumatic circuits. Here for the first time was an air cylinder with directional valve, speed control valves, and electrical actuators built-in . . . to form one compact, streamlined power unit—offering instant action, positive control.

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WRITE FOR THESE TWO BOOKLETS

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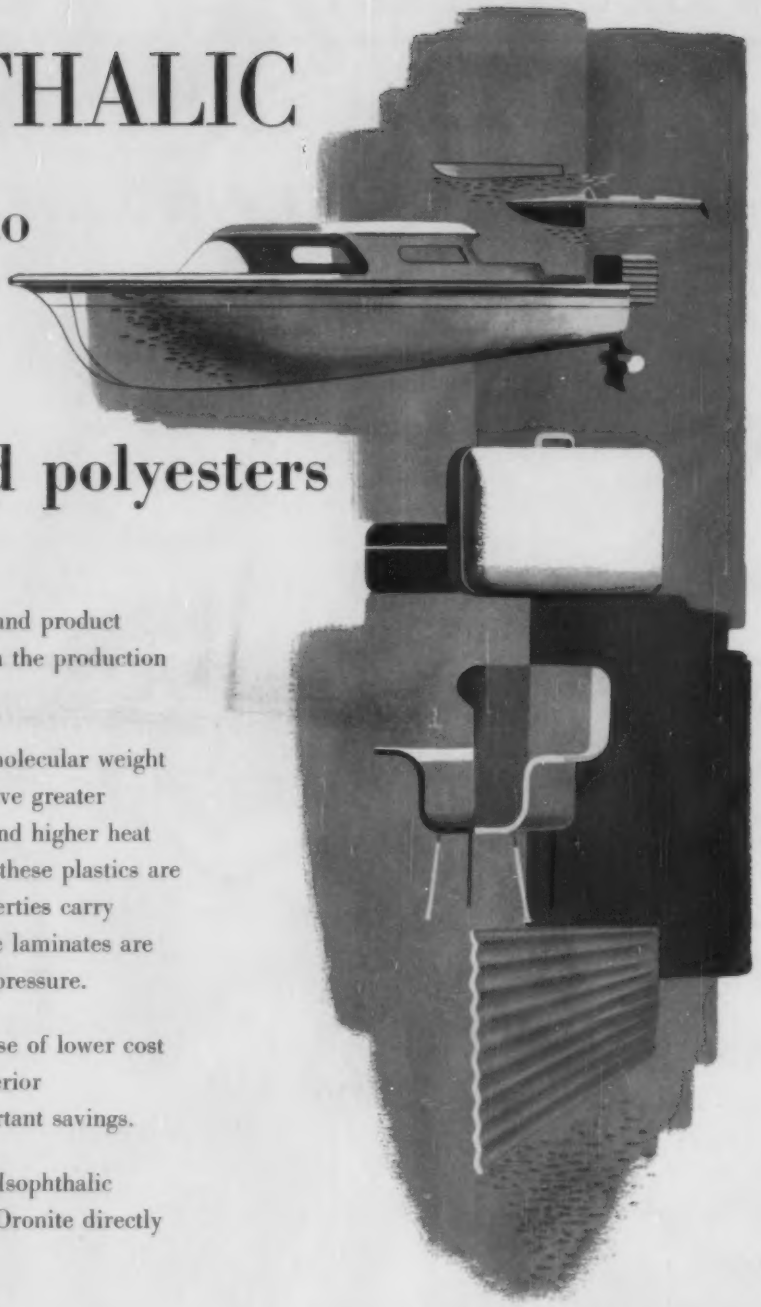
ISOPHTHALIC

the answer to superior low-cost unsaturated polyesters



Discover for yourself the cost and product advantages Isophthalic offers in the production of reinforced plastics.

You can now produce higher molecular weight products which are tougher, have greater flexural and impact strengths and higher heat distortion temperatures. When these plastics are reinforced with glass, the properties carry over into the laminates and the laminates are resistant to water erosion and pressure.

Isophthalic resins permit the use of lower cost raw materials to give you superior unsaturated polyesters at important savings.

Ask your resin supplier about Isophthalic based formulations—or, write Oronite directly for further information.

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INJECTION MOLDING

machines give you

1 LOWEST INITIAL COST

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plus:

- FULLY AUTOMATIC MOLDING
- WEIGHT FEEDERS AS STANDARD EQUIPMENT
- TWO SEPARATE MOLD PROTECTION SYSTEMS

SOLD AND SERVICED BY MOLDING SYSTEMS INC. DANIELSON, CONNECTICUT

Opening a New Era in

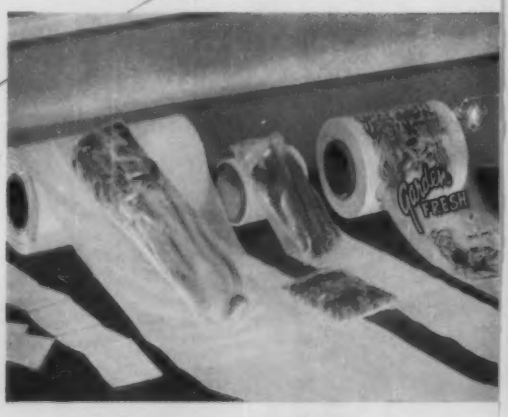
MAR

Phillips New Rigid POLYETHYLENE

IMAGINATION HEADQUARTERS

New Sales Service Laboratory

This recently completed laboratory is located at Phillips Research Center, Bartlesville, Oklahoma. Standard production-line machines are backed by a full range of evaluation and research laboratories. Here, scientists and engineers work full time on new product ideas and to develop processing techniques for the hundreds of companies that will convert Marlex 50 into plastic articles. This comprehensive service is available to all plastics processors interested in Marlex 50 polyethylene. Get in touch with your District Sales Office listed below.



MARLEX 50 for film—Outstanding protection because of low permeability and high abrasion resistance. Food can be cooked . . . medical supplies can be sterilized in sealed Marlex packages. Marlex is odorless. It safeguards flavors and fragrances.

Phillips 66

PLASTICS SALES DIVISION, PHILLIPS CHEMICAL COMPANY

A Subsidiary of Phillips Petroleum Company, Bartlesville, Oklahoma

Stop! We're out of knobs again!

Plastics Technology

LEX*50

Now Available in Commercial Quantities

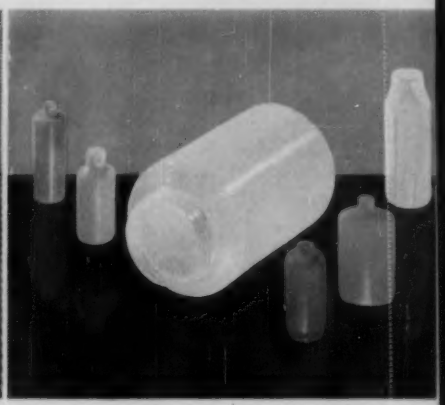
MARLEX 50 is the new kind of plastic that is tougher, stronger and more rigid than any commercial polyethylene yet available. Many new and better products can be marketed because of the unique properties of MARLEX 50. Its greater resistance to temperature extremes and chemical attack, lower permeability to liquids and gases, greater rigidity and other unusual properties offer a whole new field of profitable applications for plastics processors everywhere.

Manufacturing economies are yours through the greater strength, toughness and rigidity of MARLEX 50 and its ability to set up at higher temperatures. You can get up to 40% more items per pound of resin. You may get up to 25% faster cycle time, too. Here's a new kind of plastic to help you produce better products more profitably. MARLEX can decrease your costs by replacing more expensive materials. Call your MARLEX sales representative today.

*MARLEX is a trademark for Phillips family of olefin polymers.

MARLEX 50 for injection molding—Rich colors, glossy surfaces, fine details! Marlex 50 moldings withstand up to 250°F without losing shape . . . endure temperatures far below zero without losing toughness and pliability. Ideal for accurate vacuum moldings.

MARLEX 50 for fabrics—Easily processed into fabrics and rope with high tenacity and low elongation. Exceptional oil and chemical resistance. Withstands boiling soapy water, dry cleaning solvents, and prolonged exposure to sun and weather.



MARLEX 50 for blow molding—Rigid, tough, pure! Conforms intimately to mold surfaces. Remarkable resistance to chemicals and heat. Can be sterilized repeatedly. Excellent for bottling foods, drugs, chemicals, oils. Use Marlex 50 for caps and closures, too.

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Stop! We're out of knobs again!

The heartbreaking part about situations like this one is that it's usually some simple little part that holds up the entire unit. That's why delivery of every item is tremendously important. And that's why Boonton considers delivery time as critical a part of the whole molding business as any other step.

During our thirty-five years of processing all sorts of injection and compression molding assignments, we've developed a firm policy of setting delivery dates that we can meet. We base our promises on our work-load at the time we take an order. Since our plant is equipped with the best production machinery available (and lots of it), manned by a staff of seasoned craftsmen, we're able to quote fast, competitive dates.

But the important thing is that the date we promise is the date we deliver. We *have* to operate that way, because our experience in thinking up excuses for late deliveries is very limited.

BOONTON MOLDING CO.

BOONTON, NEW JERSEY

New York Metropolitan Area—Cortland 7-0003 • Western New York Area—Alden 7134
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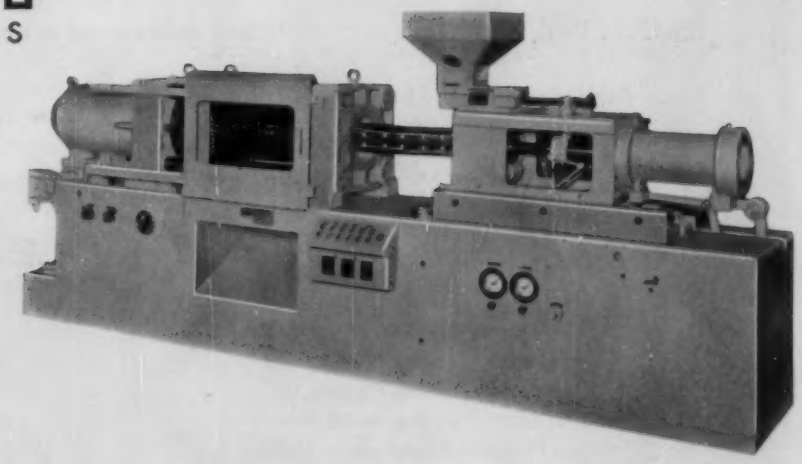
injection plastic MOLDING MACHINES

features

- ✓ Fully automatic horizontal type.
- ✓ Straight hydraulic clamping.
- ✓ No need of hazardous adjustment of stay nuts.
- ✓ Long straight heating cylinder allows quick and uniform plasticizing.
- ✓ Special clamping of heating cylinder makes exchange possible in but a few minutes.

MEIKI
MACHINES

MEIKI



MEIKI CO., LTD.
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Mizuho-ku, Nagoya, Japan

FIVE MEIKI INJECTION MOLDERS, 3 TO 80 OZ., EXHIBITED AT TOKYO INTERNATIONAL TRADE FAIR, 5 - 19 MAY, 1957

ZINC 9-V-1

HARSHAW STABILIZERS STANDARD

for the Vinyl Plastic and Coating Industries

BARIUM 1-V-4

EPOXY 7-V-2

ORGANIC 8-V-1

HEAT

CADMIUM 2-V-4

LIGHT

In these five Standard Units are all the necessary components to control effectively the degradation mechanisms that take place in polyvinyl chloride resins on aging, during heat processing or on exposure to sunlight. They are widely used alone and in combinations for specific effects in clear and opaque stocks. Their advantages have been proven over other tested materials, such as those based on tin (which frequently decolorizes effects of degradation without correcting them) or on lead (which frequently contributes to oxidation and breakdown on aging). We also supply combinations of components selected from these five Standard Units, to correct special conditions encountered in each Vinyl Processing Industry.

Write for information about stabilizers designed for versatile and inexpensive use in formulations employed in your particular vinyl processing industry.

Is it for—

- Quality Vinyl Flooring?
- Non-Plating Calendered Stocks?
- Maximum Clear Sheets?
- Non-Sulfur Staining Films?
- Low Cost Clear & Opaque Hose?
- Top Physical Properties in Rigids?
- Air-Releasing Plastisols?
- Controlled Slush Molding?

This Stabilizer System is for

CLEAR SHEETS

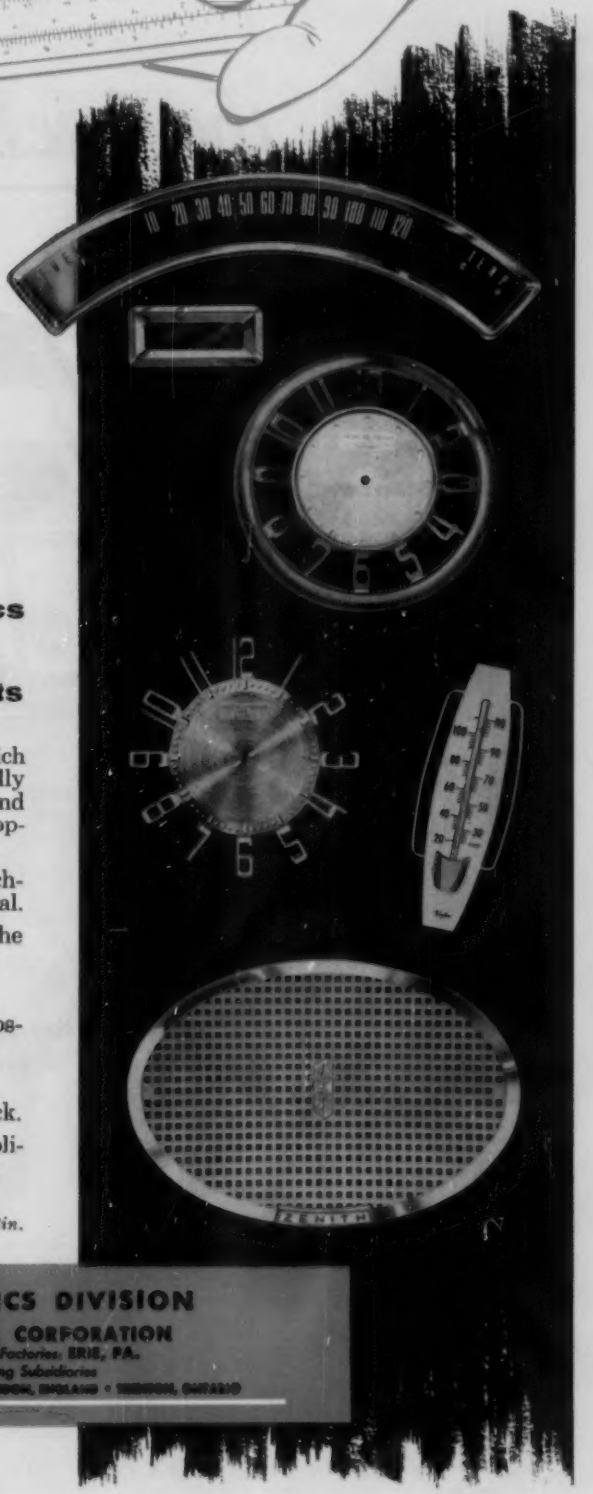
Cd 2-V-4

Org 8-V-1

The HARSHAW CHEMICAL Co.

1945 E. 97th STREET • CLEVELAND 6, OHIO

A DESIGNER'S DREAM COME TRUE



ERIE EXTERNAL METALLIZING . . .

A New Metallic Effect for Plastics that Offers New Possibilities to the Designer of Many Products

ERIE External Metallizing is a process by which an evaporated metal film is deposited on a specially developed, firmly adherent, organic undercoat, and is then protected by a clear and mar-resistant top-coat. It offers these qualities to the designer:

- Gives to plastic an economical finish equal in richness and lasting luster to electro-plating on metal.
- Special color effects can be obtained to suit the customer's requirements.
- Will not tarnish, pit, or rust.
- Maintains its brilliance under adverse atmospheric conditions.
- Passes rigid score-and-tape tests.
- Resistant to humidity, fading, and thermal shock.

ERIE welcomes your inquiries regarding the applicability of External Metallizing to your product.

Write for a copy of the new ERIE Plastics Facilities Bulletin.

ERIE plastics

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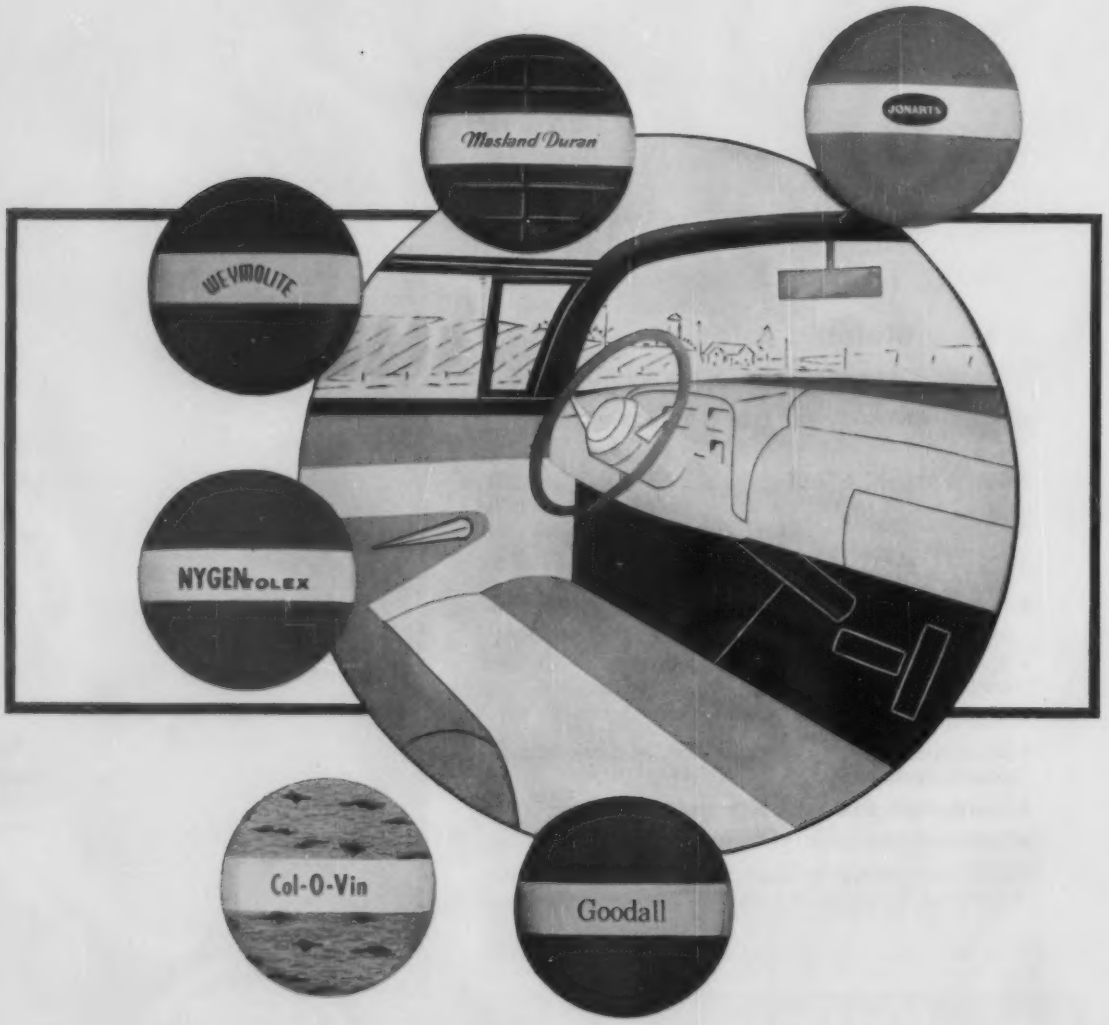
the finest vinyls are made



TODAY'S FINE CARS OWE THEIR STUNNING INTERIORS TO VINYLS!

with PLASTOLEIN® PLASTICIZERS

The famous names at left sell a major share of the upholstery fabrics you see in America's cars today. These high-quality vinyls are designed specifically to satisfy the demands of modern motorists for appearance *and durability!* Nothing is spared in using raw materials that produce the highest possible quality. That's why leading manufacturers use Emery Plastolein Plasticizers, to get that extra quality that makes their fabrics perform so well for so long.

If *you* are interested in producing high quality sheeting, coated fabrics, film and extrusions, you *too* should use Plastolein Plasticizers in your plasticizer system. The coupon below will bring you all details about the unsurpassed low-temperature performance of Plastolein 9058 DOZ, the outstanding permanence of Plastolein 9720 Polymeric, as well as data on other Emery Plastolein Plasticizers. Mail it today.

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Please send me the 32-page Emeryfacts titled, "Plastolein Plasticizers."

Name.....Title.....
Firm.....
Address.....
City.....State.....

How high load capacity is built into less space in Dodge-TIMKEN All-Steel pillow block

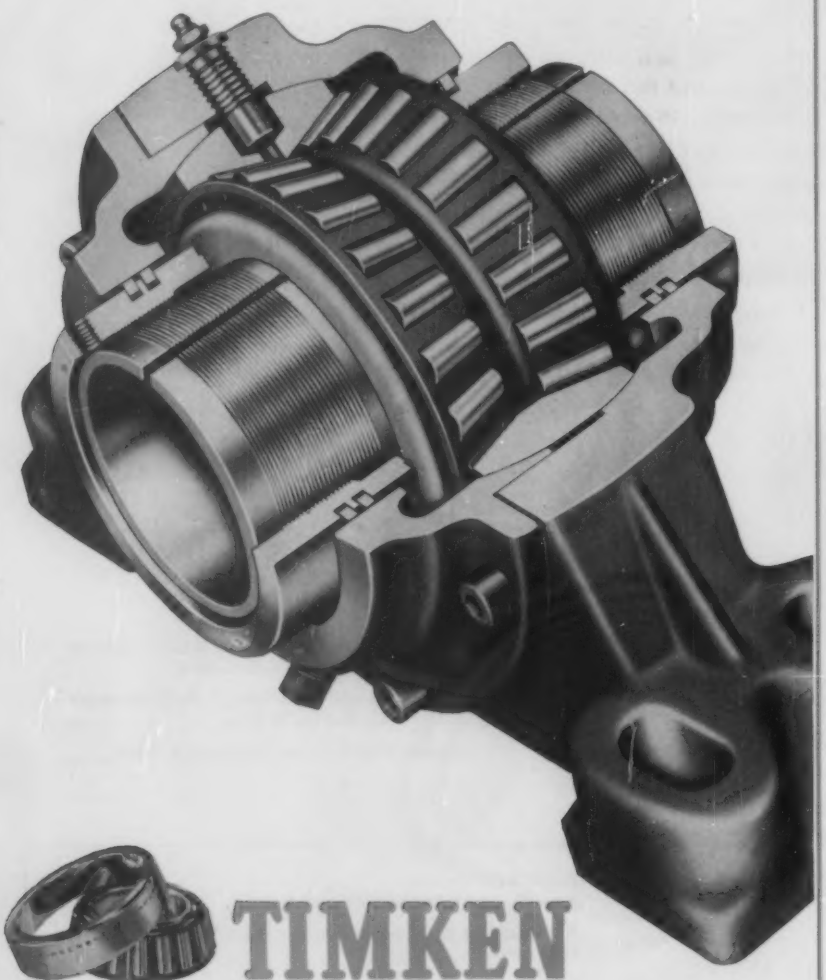
THIS rugged Dodge-Timken pillow block packs more capacity in less space than ever before. All-steel construction gives it extra strength and durability. The design is compact. No special thrust devices that take up extra space are needed—the two-row Timken® tapered roller bearing takes *both* radial and thrust loads in any combination. And full line contact between the rollers and races assures high load capacity.

The cutaway view below shows the bearing. It is of special design, with tapered bore and self-aligning spherical outer surface—never requires adjustment. As in all Timken bearings, races and rollers are case-carburized and have tough, shock-resistant cores under hard, wear-resistant surfaces. Under normal conditions, the Timken bearing will last the life of the machinery with which the pillow block is used.

In addition to the all-steel pillow block shown here, Timken bearings are also used in the Type "E", Double-Interlock, Type "C", and Special-Duty pillow blocks—other versatile pillow blocks in the Dodge-Timken line with a wide variety of uses in industry.

To be sure of the finest bearing steel, we make our own—America's only bearing manufacturer that does. No other bearing can give you all the advantages you get with Timken bearings. Include them in your design plans... specify them for the machines you buy or build. Look for the trademark "Timken"—it's on the bearing that makes any machine run better. The Timken Roller Bearing Company, Canton 6, Ohio. Canadian plant: St. Thomas, Ont. Cable: "TIMROSCO".

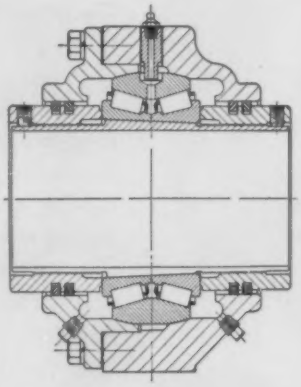
This symbol on a product means its bearings are the best.



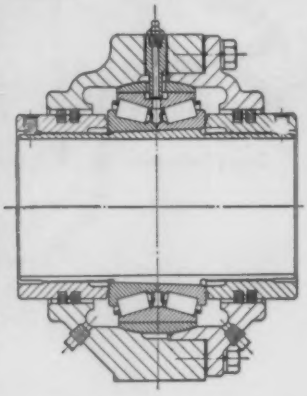
TIMKEN

TRADE-MARK REG. U. S. PAT. OFF.

TAPERED ROLLER BEARINGS ROLL THE LOAD



How **DODGE MANUFACTURING CORPORATION,** Mishawaka, Ind., mounts Timken bearings in the Dodge-Timken All-Steel pillow block. Above: non-expansion block with fixed bearing. Below: expansion block with floating bearing.



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Urethane Producers

Assured Large-Scale Supply of a complete line of diisocyanates from our new multimillion-dollar Moundsville, W. Va. NACCONATES* (diisocyanates) plant. With this major plant on stream, urethane producers can confidently schedule volume production.

Comprehensive Product Data in a series of six fact-filled National Aniline Technical Bulletins. We believe that this is the most complete "product-data package" on diisocyanates available.

Application Data Sheets on many principal formulations. These Data Sheets contain suggested procedures based on the most recent information developed in our Buffalo Research Laboratories.

We invite you to use our across-the-boards help to broaden your knowledge of urethanes. The coupon is for your convenience.

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Akron Atlanta Boston Charlotte Chattanooga Chicago
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NATIONAL ANILINE Allied Chemical

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TECHNICAL BULLETINS

( ) I-17 NACCONATES . . . General Product Information
( ) I-17A NACCONATE 80 (Tolylene Diisocyanate Isomeric Mixture)
( ) I-17B NACCONATE 65 (Tolylene Diisocyanate Isomeric Mixture)
( ) I-17C NACCONATE 100 (2,4 Tolylene Diisocyanate)
( ) I-17D NACCONATE 200 (3,3'-Bitolylene 4,4'-Diisocyanate) (TODI)
( ) I-17E NACCONATE 300 (Diphenylmethane 4,4'-Diisocyanate) (MDI)
( ) I-17F NACCONATE 310 (3,3'-Dimethyldiphenylmethane 4,4'-Diisocyanate) (DMMDI)

APPLICATION DATA SHEETS

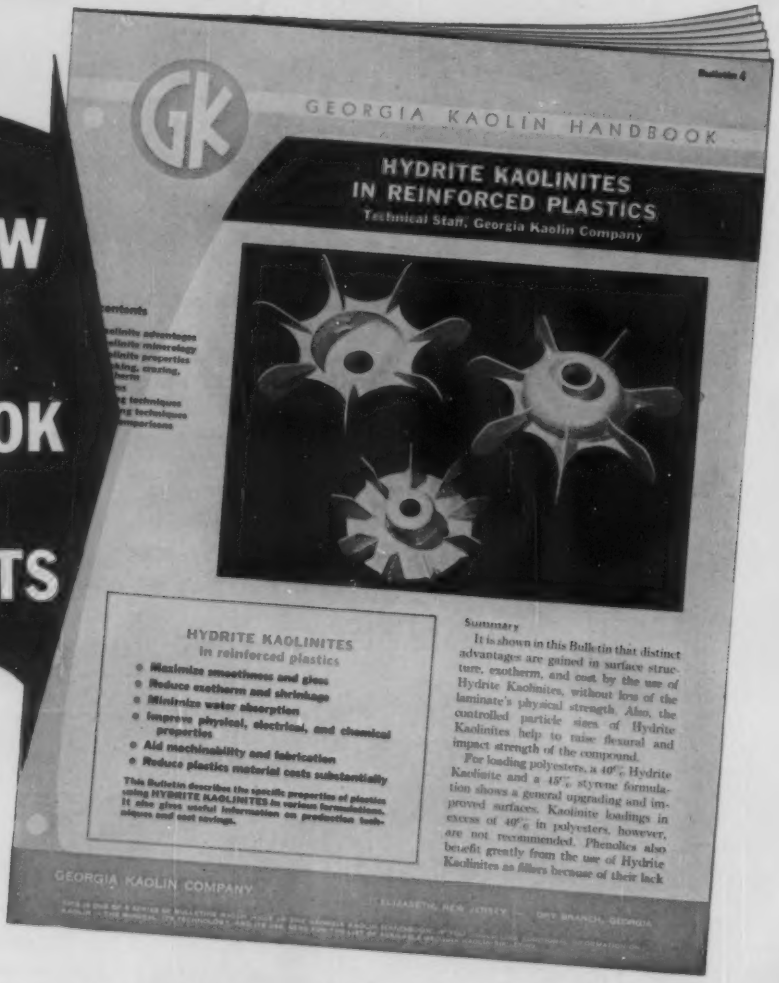
( ) 41156—Flexible Foams
( ) 7956—Semi-rigid Foams
( ) 112356—Protective Coatings

G-10

HOW HYDRITE KAOLINITES

improve properties and reduce cost of reinforced plastics

THIS NEW FREE HANDBOOK GIVES THE FACTS


GEORGIA KAOLIN HANDBOOK
HYDRITE KAOLINITES IN REINFORCED PLASTICS
Technical Staff, Georgia Kaolin Company
HYDRITE KAOLINITES
in reinforced plastics
Maximize smoothness and gloss
Reduce exotherm and shrinkage
Minimize water absorption
Improve physical, electrical, and chemical properties
Aid machinability and fabrication
Reduce plastics material costs substantially
This Bulletin describes the specific properties of plastics using HYDRITE KAOLINITES in various formulations. It also gives useful information on production techniques and cost savings.
Summary
It is shown in this Bulletin that distinct advantages are gained in surface structure, exotherm, and cost by the use of Hydrite Kaolinites, without loss of the laminate's physical strength. Also, the controlled particle sizes of Hydrite Kaolinites help to raise flexural and impact strength of the compound.
For loading polyesters, a 40% Hydrite Kaolinite and a 45% styrene formulation shows a general upgrading and improved surfaces. Kaolinite loadings in excess of 40% in polyesters, however, are not recommended. Phenolics also benefit greatly from the use of Hydrite Kaolinites as fillers because of their lack
GEORGIA KAOLIN COMPANY

Our new Bulletin 4, is packed with information regarding the effects of HYDRITE KAOLINITE FILLERS in reinforced plastics.

It tells how HYDRITE KAOLINITES maximize smoothness and gloss; reduce exotherm and shrinkage; minimize water absorption; improve physical, electrical and chemical properties; aid machinability and fabrication and reduce plastics material costs substantially.

The Bulletin describes the specific properties of plastics using HYDRITE KAOLINITES in various formulations. It also gives useful information on production techniques and cost savings.

Send for your free copy today.

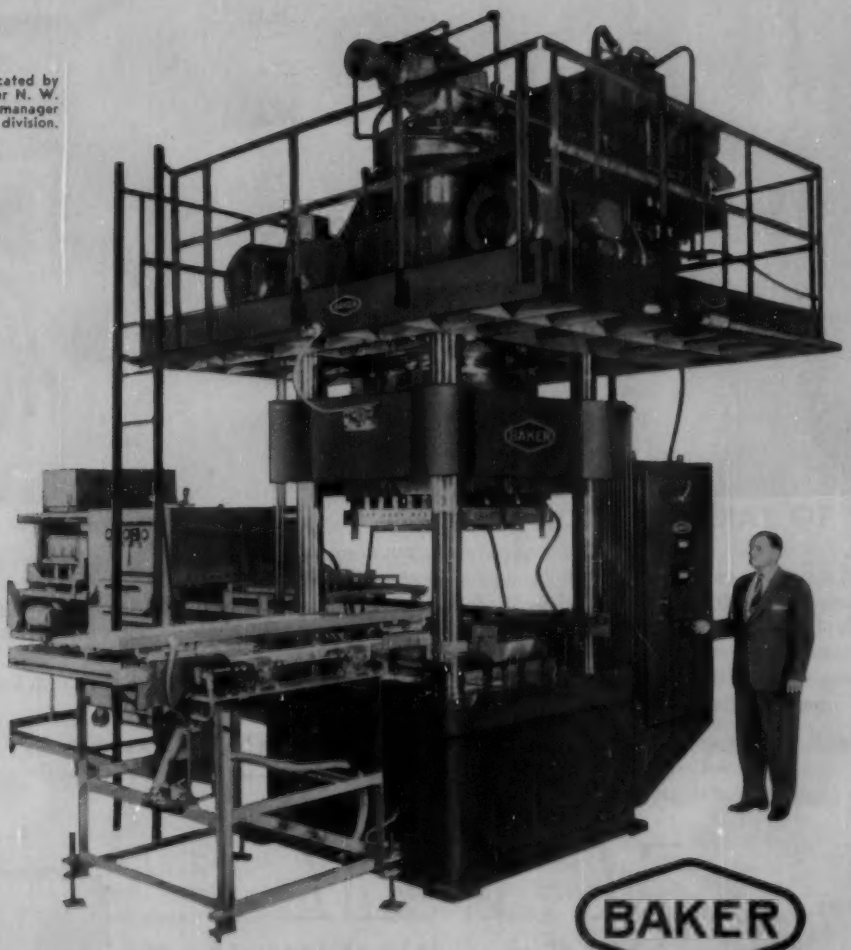
GEORGIA KAOLIN COMPANY

433 North Broad Street, Elizabeth, N. J.

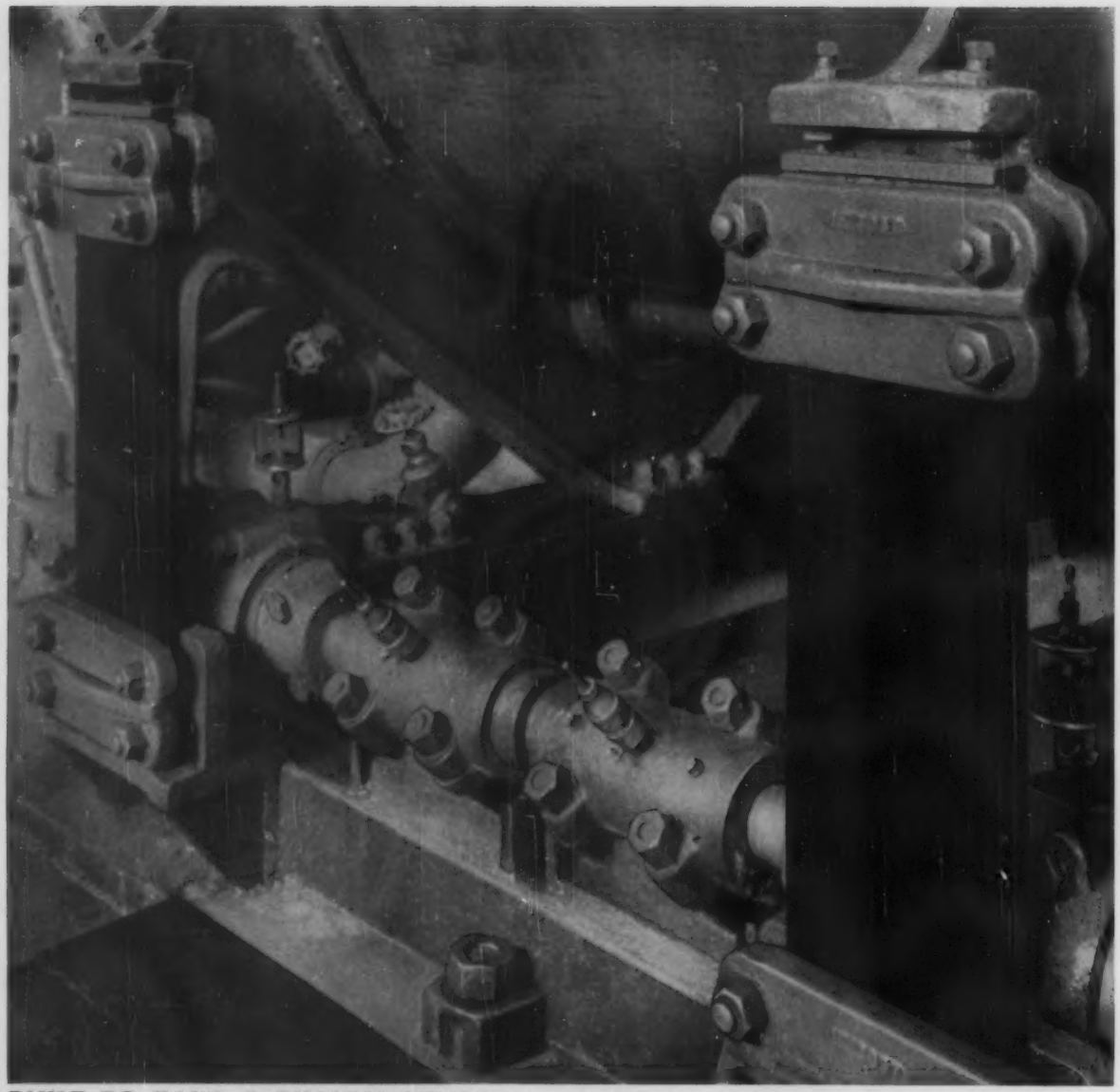
Never before in the industry! Now for the first time, you can mold larger parts *automatically*. In spite of its great capacity, this Baker press performs every known function in automatic molding, and in any relationship. Time and length of function are instantly adjustable. You choose the shortest molding cycle for any job. Also available with Westinghouse CYPAK controls. Get the facts. Write Baker Brothers, Inc., 1010 Post Street, Toledo 10, Ohio.

New . . . a big 450-ton press that's fully automatic

Size of the press is indicated by comparing with six-footer N. W. Oberle, merchandising manager of Baker's plastic press division.



BAKER
MOLDING MACHINES



BUILT TO TAKE A BILLION BENDS – Four of these laminated plastic springs support the entire weight of a 1500 gallon oscillating tank on a Bird paper stock screen in operation at Taylor Fibre Co. of Norristown, Pa. When filled to capacity, the screen vat weighs 13,000 lbs., and is constantly oscillating at the rate of 300 cycles per minute for 24 hours a day, 6 days a week. During the more than 10 years that these springs or "shake boards" have supported the weight of this vat, each of them has been flexed more than a *billion* times – considerably more times than materials normally utilized for this purpose are expected to withstand. – And despite the humid conditions and constant presence of "free water", there has yet to be any sign of deterioration. The springs were made from one of Taylor Fibre Co.'s own laminated plastics in which Mount Vernon fabrics are used.

This is another example of how fabrics made by Mount Vernon Mills, Inc. and the industries they serve, are serving America. Mount Vernon engineers and its laboratory facilities are available to help you in the development of any new fabric or in the application of those already available.

UNIFORMITY Makes The Big Difference In Industrial Fabrics

Mount Vernon Mills, inc.

A LEADER IN INDUSTRIAL TEXTILES

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announcing
dinonyl phthalate

—a new Eastman plasticizer

DNP offers outstanding performance at significant savings

We invite you to evaluate the usefulness of this new plasticizer in your vinyl formulations. Our testing indicates the following advantages:

LOW COLOR • Dinonyl phthalate has an initial color of less than 25 APHA. After heating for 2 hours at 220°C., retention of this low color has proved excellent.

PERMANENCE • All permanence tests indicate dinonyl phthalate to be equivalent or superior to dioctyl phthalate. These tests include resistance to high temperatures, activated carbon volatility, migration and extraction by soapy water and heptane.

ECONOMY • Based on current prices of vinyl resins and plasticizers, 102 square feet of dinonyl phthalate plasticized vinyl compounds can be produced for the same cost as 100 square feet of compounds plasticized with DOP. This savings assumes the use of 57 parts per hundred resin of dinonyl phthalate as compared with 50 PHR of dioctyl phthalate. Basis for this is the greater amount of dinonyl phthalate required to produce an equivalent modulus and the resultant lower density of the dinonyl phthalate formulations.

SUPERIOR ELECTRICAL PROPERTIES • Dinonyl phthalate exhibits a high dielectric constant, a low dissipation factor and a volume resistivity equal to or better than that of electrical grade dioctyl phthalate. These excellent properties recommend dinonyl phthalate for use in vinyl plastics designed for electrical applications.

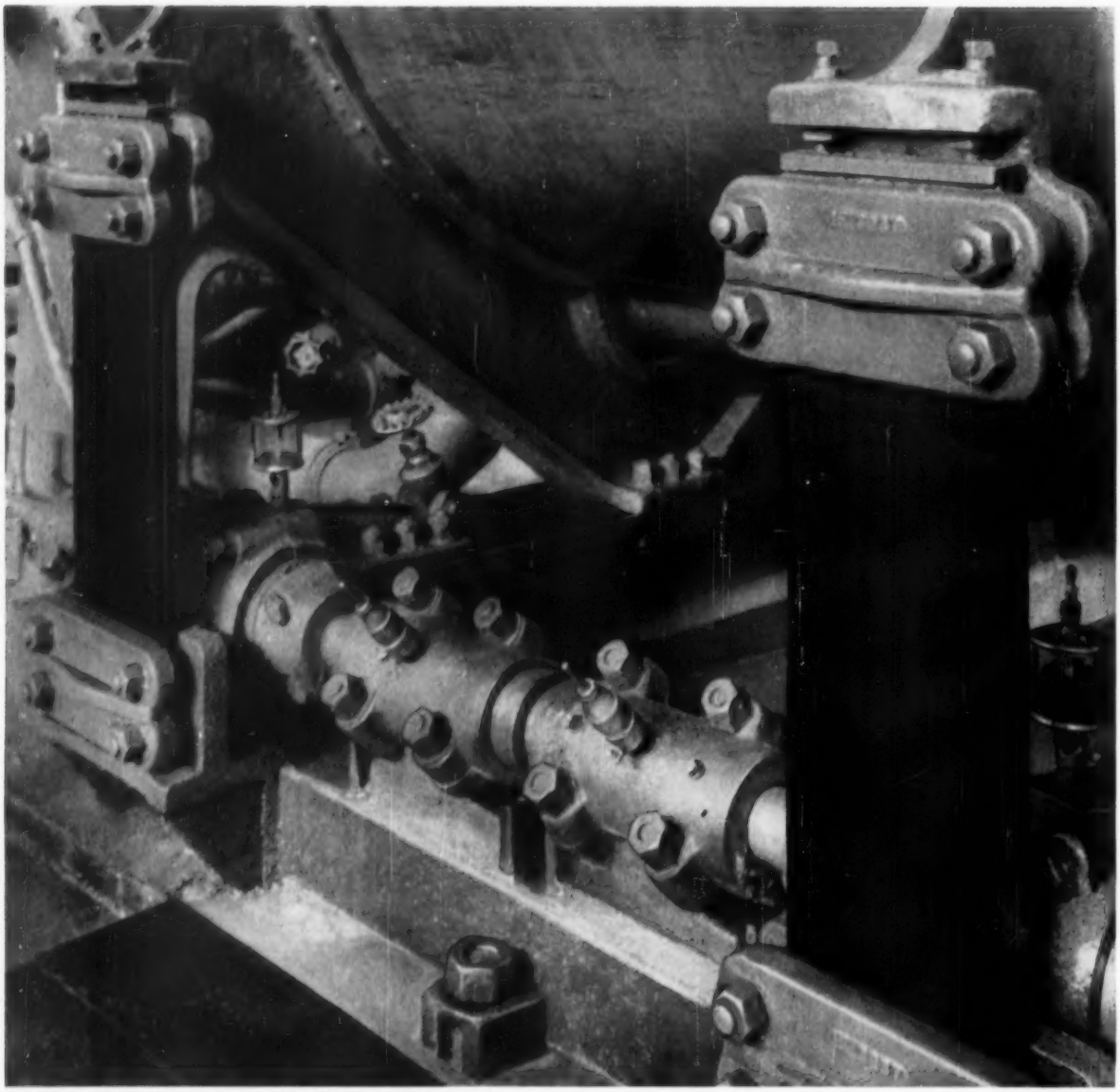
EASY HANDLING • Dinonyl phthalate is easily milled into vinyl resins.

USEFUL IN PLASTISOLS • Low initial viscosity build-up is an important feature of vinyl plastisols containing dinonyl phthalate. Films cast from these plastisols show good low temperature properties and low plasticizer volatility. Dinonyl phthalate plastisols are suitable for both slush and cavity molding.

Write for working samples and further technical information on this promising addition to the plasticizers available to vinyl formulators.

Eastman
CHEMICAL PRODUCTS, INC.
KINGSPORT, TENNESSEE
subsidiary of EASTMAN KODAK COMPANY

SALES OFFICES: Eastman Chemical Products, Inc., Kingsport, Tennessee; New York City; Framingham, Mass.; Cincinnati; Cleveland; Chicago; St. Louis; Houston. **West Coast: Wilson Meyer Co.,** San Francisco; Los Angeles; Portland; Salt Lake City; Seattle.



BUILT TO TAKE A BILLION BENDS – Four of these laminated plastic springs support the entire weight of a 1500 gallon oscillating tank on a Bird paper stock screen in operation at Taylor Fibre Co. of Norristown, Pa. When filled to capacity, the screen vat weighs 13,000 lbs., and is constantly oscillating at the rate of 300 cycles per minute for 24 hours a day, 6 days a week. During the more than 10 years that these springs or "shake boards" have supported the weight of this vat, each of them has been flexed more than a *billion* times – considerably more times than materials normally utilized for this purpose are expected to withstand. – And despite the humid conditions and constant presence of "free water", there has yet to be any sign of deterioration. The springs were made from one of Taylor Fibre Co.'s own laminated plastics in which Mount Vernon fabrics are used.

This is another example of how fabrics made by Mount Vernon Mills, Inc. and the industries they serve, are serving America. Mount Vernon engineers and its laboratory facilities are available to help you in the development of any new fabric or in the application of those already available.

UNIFORMITY Makes The Big Difference In Industrial Fabrics

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announcing
dinonyl phthalate

—a new Eastman plasticizer

DNP offers outstanding performance at significant savings

We invite you to evaluate the usefulness of this new plasticizer in your vinyl formulations. Our testing indicates the following advantages:

LOW COLOR • Dinonyl phthalate has an initial color of less than 25 APHA. After heating for 2 hours at 220°C., retention of this low color has proved excellent.

PERMANENCE • All permanence tests indicate dinonyl phthalate to be equivalent or superior to dioctyl phthalate. These tests include resistance to high temperatures, activated carbon volatility, migration and extraction by soapy water and heptane.

ECONOMY • Based on current prices of vinyl resins and plasticizers, 102 square feet of dinonyl phthalate plasticized vinyl compounds can be produced for the same cost as 100 square feet of compounds plasticized with DOP. This savings assumes the use of 57 parts per hundred resin of dinonyl phthalate as compared with 50 PHR of dioctyl phthalate. Basis for this is the greater amount of dinonyl phthalate required to produce an equivalent modulus and the resultant lower density of the dinonyl phthalate formulations.

SUPERIOR ELECTRICAL PROPERTIES • Dinonyl phthalate exhibits a high dielectric constant, a low dissipation factor and a volume resistivity equal to or better than that of electrical grade dioctyl phthalate. These excellent properties recommend dinonyl phthalate for use in vinyl plastics designed for electrical applications.

EASY HANDLING • Dinonyl phthalate is easily milled into vinyl resins.

USEFUL IN PLASTISOLS • Low initial viscosity build-up is an important feature of vinyl plastisols containing dinonyl phthalate. Films cast from these plastisols show good low temperature properties and low plasticizer volatility. Dinonyl phthalate plastisols are suitable for both slush and cavity molding.

Write for working samples and further technical information on this promising addition to the plasticizers available to vinyl formulators.

Eastman
CHEMICAL PRODUCTS, INC.
KINGSPORT, TENNESSEE
subsidiary of EASTMAN KODAK COMPANY

SALES OFFICES: Eastman Chemical Products, Inc., Kingsport, Tennessee; New York City; Framingham, Mass.; Cincinnati; Cleveland; Chicago; St. Louis; Houston. **West Coast: Wilson Meyer Co.,** San Francisco; Los Angeles; Portland; Salt Lake City; Seattle.

HARSHAW PIGMENTS

INORGANIC PIGMENTS

Harshaw Pigments find widespread application in industry, especially where an inorganic type of pigment is desirable, such as in automobile and sign enamels and lacquers, permanent inks, resin and latex emulsion paints, plastics, artificial leather, fire-retardant coatings, rubber goods, wallpaper and artists colors. Wherever they are used, Harshaw colors show outstanding brilliance, strength and light fastness.

Yellows... Cadmium Lithopones and C. P. Cadmium Pigments—Primrose, Lemon and Golden
Sun Yellow N and C—extremely durable pastel yellow pigments (Nickel titanium dioxide complex.)

Oranges.. Cadmium Lithopones and C. P. Cadmium Pigments—Orange and Orange Red

Reds..... Cadmium Lithopones and C. P. Cadmium Pigments—Light Red, Medium Red, and Dark Red

Maroons.. Cadmium Lithopones and C. P. Cadmium Pigments—Maroon and Dark Maroon

Blues..... Cobalt Blue and Cerulean Blue

White.... Antimony Oxide

Other Colors and Pigments

Harshaw also offers a broad line of organic pigment colors, as well as a full line of Aurasperse organic and oxide dispersions. The dry colors are for general color uses, while Aurasperse dispersions find application in emulsion paint formulations.

A partial listing

ORGANIC PIGMENTS
Dry Colors

Hansa Yellows
Benzidene Yellows
Pigment Scarlet
Fire Red Toner
Maroon Toner
Permanent Orange
Madder Lakes
Permanent Green
Blue and Violet Toners
Permanent Purples

DISPERSED PIGMENTS
Aurasperse Colors

Hansa Yellows
Yellow Oxides
Green Gold
Chlorpara Red
Toluidine Red
Naphthol Reds
Alizarine Reds
Chlornaphthol Reds
Phthalocyanine Blue
Ultramarine Blue
Pigment Green B
Phthalocyanine Green
Chromium Green Oxide
Carbon Black
Red Oxides

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Harshaw Aurasperse Colors
Harshaw Pigment Scarlet 25 AD
Harshaw Benzidine Toner Yellow 2222

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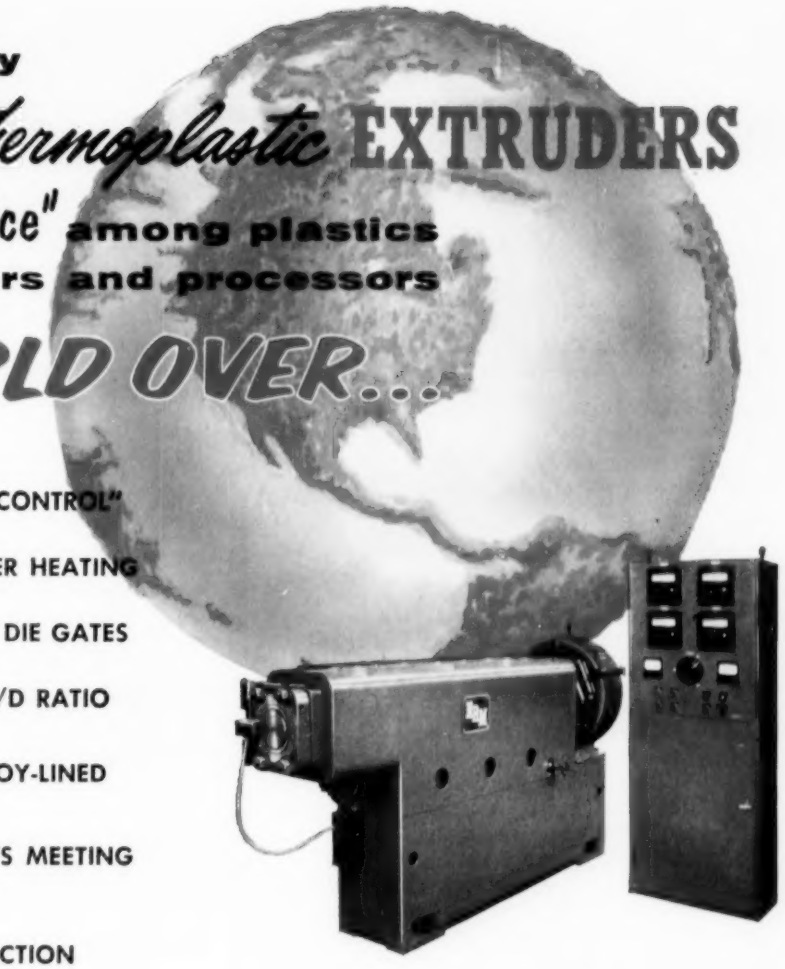
are "first choice" among plastics manufacturers and processors

THE WORLD OVER...



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To get more information, call your Chromalox Representative or write us direct for the Bulletins listed. In addition, if you will tell us your problem, we will send you a case history of an identical or similar application.

With Chromalox Electric Far-Infrared, you benefit in all these operations:
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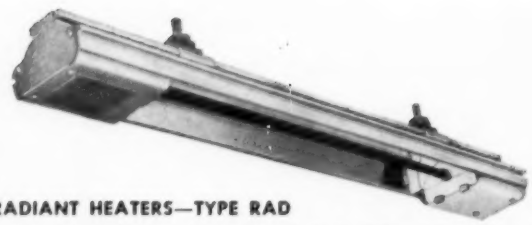
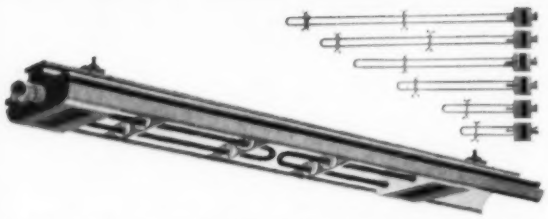


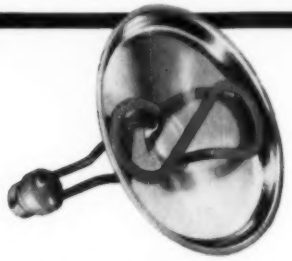
RADIANT HEATERS—TYPE RAD

For single assembly or in banks. Two bolts in sliding clamps facilitate mounting; two wires to connect. Six standard lengths, 14 standard wattages. Housing is rigid extruded aluminum with brightly polished parabolic non-oxidizing reflector. Write for Bulletin CS-604.



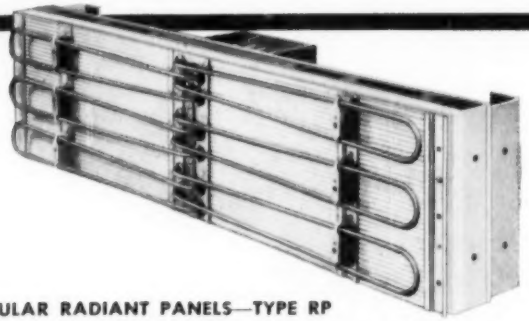
ADJUSTABLE AREA RADIANT HEATERS—TYPE U-RAD

Lets you match heat area to work area. Choose one basic housing to match your largest work. Into this housing install any of 6 different heaters to get up to 27 heated lengths as job sizes change. Bulletin CS-607



METARAY® LAMP REPLACERS—TYPE FRB

Now any infra-red reflector bank can be equipped with glassless, glareless, self-cleaning Metaray elements. Radiation is spread more uniformly from the larger element configuration. Write for Bulletin L-1104.



MODULAR RADIANT PANELS—TYPE RP

A high-intensity heat source in four standard sizes. Modular panels completely factory assembled with built-in continuous bus, reflector, insulation, frame and mounting. Lets you tailor heat source exactly to process requirements. Write for Bulletin CS-606.

THE RIGHT HEAT, EASILY DUPLICATED AT THE TURN OF A DIAL

Inexpensive, automatic input controllers provide accurate temperatures. As required by different work, heater input can be set anywhere from 4 to 100% of capacity. Better control, combined with better distribution, give more uniform product quality and higher production.

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THE SUPERIOR COLOR CONCENTRATE FOR EXTRUSION MOLDING

It takes the showmanship of COLOR to capture the attention of the consumer. Those pellets of UNICOLOR going into the extrusion molding machine are just beginning to do their showmanlike job of providing the stimulus of COLOR to the sale of plastic belting.

UNICOLOR is a resin color concentrate that forms a molecular bond with the thermoplastic involved. It is so rich in COLOR-POWER that it is to be diluted at a ratio of **twenty-four to one.** The result is a plastic product with the attention-commanding color that rings up sales.

Westchester Plastics, Inc. has pioneered the field of color. We have available thousands of specially matched colors in polyethylene and most other thermoplastic materials. Advise us of the resin you intend to use and the color you require. We will send you a sample for evaluation by your staff.

remember! the color makes the SALE!

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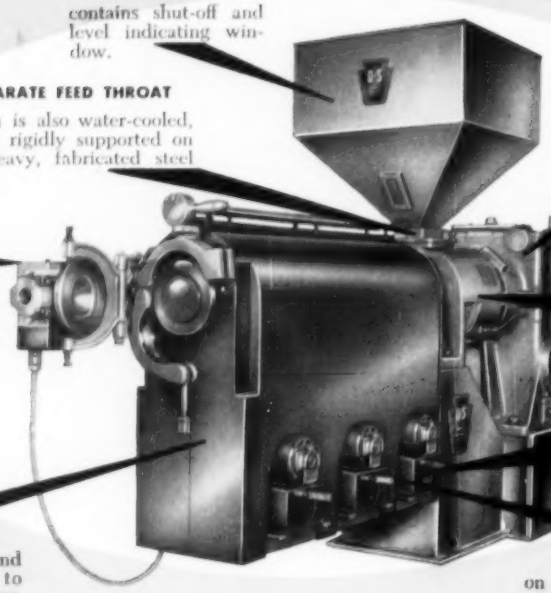
Manufacturers and Developers of Unicolor and Formacolor

*Pliothene, Formacolor, Unicolor® T.M. Reg. U.S. Pat. Off.

Check These Features of

THERMA-FIN EXTRUDERS*



FEED HOPPER
contains shut-off and level indicating window.

SEPARATE FEED THROAT
section is also water-cooled, and is rigidly supported on the heavy, fabricated steel base.

"STREAM-FLO" CROSSHEAD
has quick opening clamp, and is hinged to facilitate quick servicing. This electrically heated crosshead has been designed so that a minimum amount of compound is carried in the head.

BLOWER HOOD
deflects air stream around the THERMA-FINS to provide *uniform cooling.* Hood contains an inner stainless steel liner insulated from the outer cover.

SMOOTH FLOW OF POWER
provided by hardened worm and special high capacity bronze worm wheel drive results in *steady, non-pulsating* stock screw drive.

THRUST HOUSING
section is water-cooled, and contains a rugged steel thrust sleeve that is supported on heavy-duty roller thrust and radial bearings.

BLOWER
of large capacity cools each heat zone. Temperature of each heat zone is controlled independently.

ADJUSTABLE DAMPER
on each zone controls amount of natural draft or blower capacity. Closed oven effect is created by closing dampers and shutting blowers off.

OTHER OUTSTANDING FEATURES:

- **DAVIS-STANDARD® THERMA-FINS,** which clamp over the cylinder in each zone, are deep-finned, aluminum castings with cast-in calrod range type heaters of ample capacity.
- **STOCK SCREW** of constant lead and diminishing depth is made of special alloy steel. Flights are hardened, and entire polished surface is protected by hard chrome plate. Water cooling fixture is provided for hollow screw.
- **PROPORTIONING TYPE INSTRUMENTS** automatically maintain accurate temperature control.
- **SHOCK-MOUNTED CABINET** houses temperature control instruments and the blower control switches.
- **STANDARD AND SUPER MODELS** available in 1½", 2", 2½", 3¼", 4½", and 6" bore sizes.

* U. S. Patents Pending

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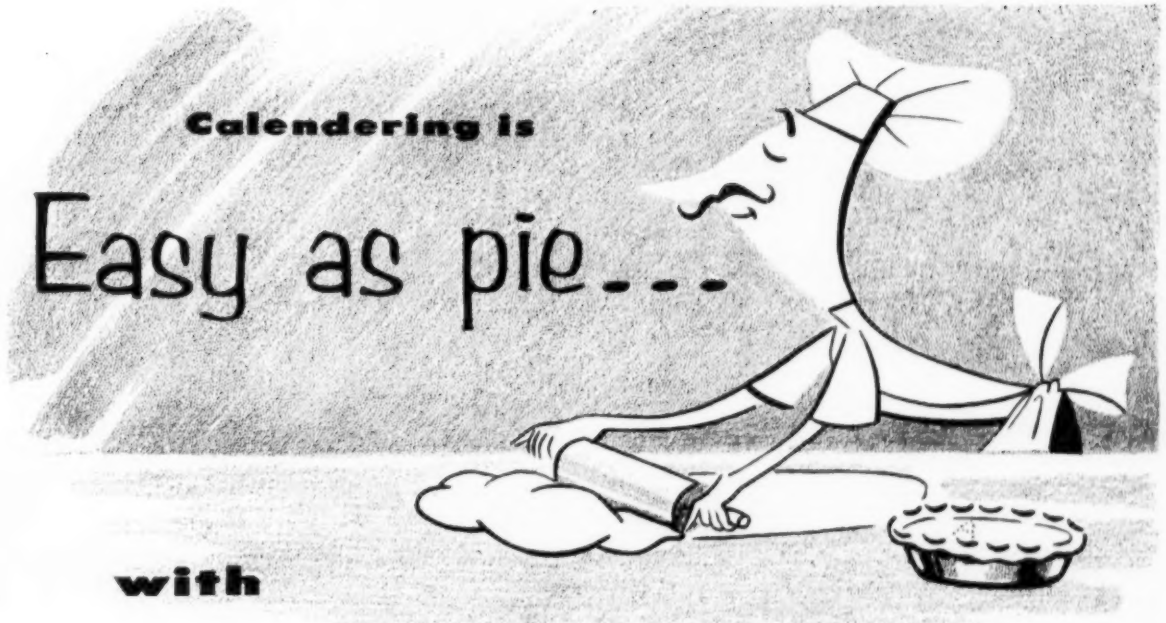

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New HIGH-IMPACT THERMOPLASTIC RESIN

THE PERFECT RESIN FOR THE MANUFACTURE OF ANY PRODUCT THAT DEMANDS . . .

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- Economic Molds
- Low Brittle Point
- High Heat-Distortion

Calendering . . . Injection Molding . . . . . Extrusion . . . It's CYCOLAC for any or all Three Methods

Calendered sheet stock for post-forming operations; molded items for high gloss, dimensional stability; extruded items for high production of sheet, pipe, or profiles. All products characterized by high-impact resistance, bright colors, chemical resistance, low brittle point, low creep and excellent electrical properties.

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Division of BORG-WARNER
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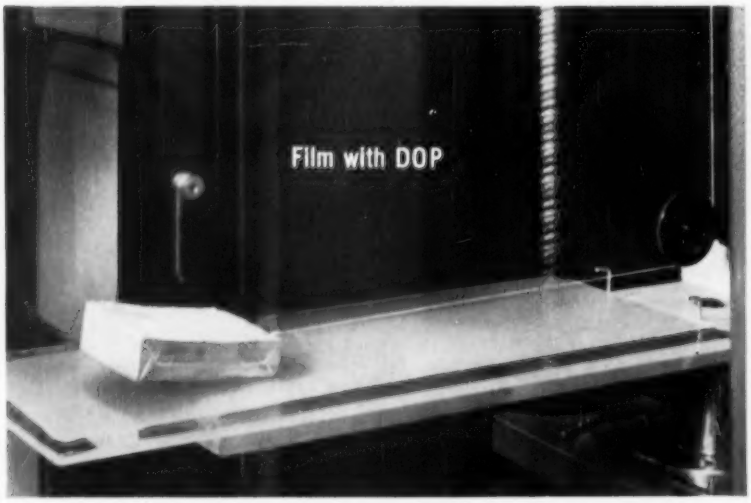
MARBON CHEMICAL . . . *Precision Resins for Precision Made Products*

More surface slip for vinyls

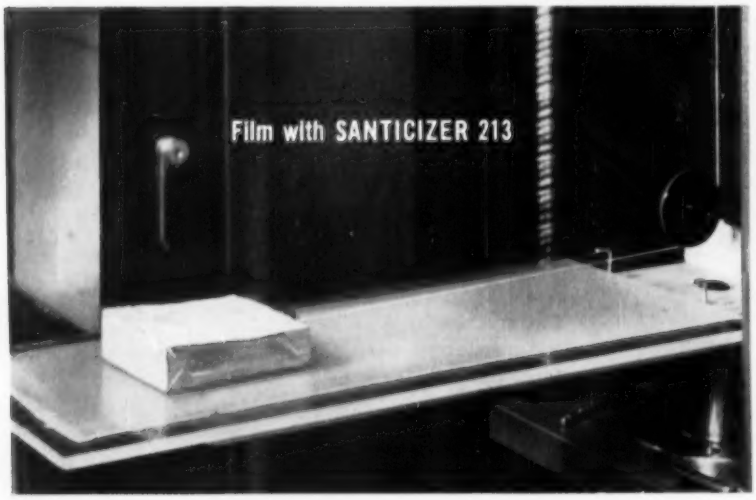
Better viscosity/fusion balance

Easy mold release

ONLY SANTICIZER 213 GIVES



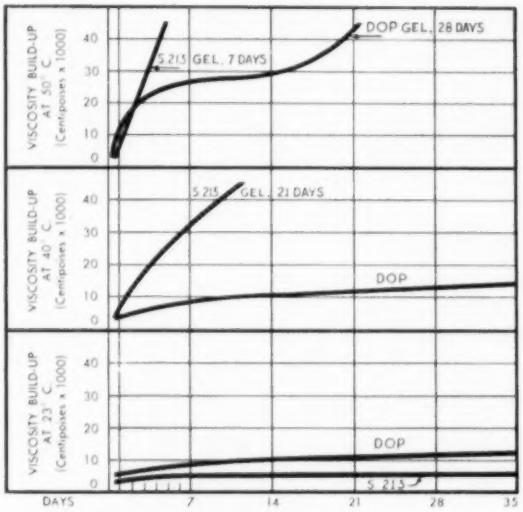
PVC film plasticized with DOP sticks to other surfaces.
Santicizer 213 lets PVC film slip across surfaces easily.



1. More surface slip for vinyls

Saniticizer* 213 has the unique ability to reduce the sticking quality of a PVC plastic surface. Instron tester pulling a film-wrapped block shows the greater surface slip imparted to the film plasticized by Santicizer 213. Surface of other film "grabs" and sticks. Coefficient of friction for Santicizer 213 is only about 40% of that for dioctyl phthalate formulations.

YOU ALL THESE ADVANTAGES



2. Better viscosity/fusion balance

Santicizer 213 is one of the fastest-fusing primary plasticizers available. These charts show how Santicizer 213 quickly gels and fuses at elevated temperatures—yet stays at low viscosity at low temperatures. Formulation: Opalon* 410 PVC resin, 100 parts; plasticizer, 80 parts.

3. Easy mold release

When Santicizer 213 is included in PVC formulations (in amounts as low as 35% of the total plasticizer concentration), mold-release ease is greatly enhanced. As a result, Santicizer 213 helps you increase your production rates and decrease the number of rejects due to mold-release distortion.

Want to improve any of these products?

To increase the "slip" of upholstery, tubing, wire coating, rolls of coated or filmed plastics...

To improve the viscosity/fusion balance of PVC formulations . . .

To speed the mold release of toys, masks, sink mats, head guards . . .

Our Technical Service Department will help you test Santicizer 213 in your operation. Monsanto supplies almost FIFTY different plasticizers of SEVEN basic types. Call on Monsanto for one-stop service, mixed bulk shipments at bulk prices, and expert technical advice.

Organic Chemicals Division
MONSANTO CHEMICAL COMPANY
Dept. PL-6, Box 478, St. Louis 1, Missouri

With no vested interest in any single plasticizer, Monsanto develops plasticizing systems tailor-made to fit your needs.

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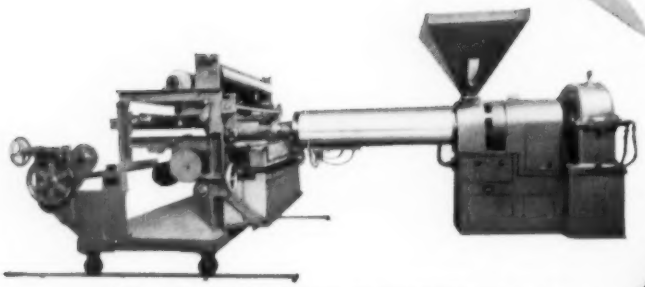
From 2" Thru 8" with screw lengths of 16 or 20 Diameters. • Hard corrosion resistant liners. • Heavy duty thrust and radial bearings with force feed lubrication. • Completely prewired temperature control cabinet. • Screw speed tachometer. • Precision ground screws. • Large feed hopper with sight glass and cut-off slide. Complete installations for film, sheet, pipe, shapes.



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...for rugged strength ...added beauty in vinyl flooring

Vinyl flooring plasticized with Benzoflex 9-88 is easier to process, gives a higher gloss and greater durability.

This clear, low-cost, stable, mild-smelling plasticizer–one of eight benzoate esters from Tennessee–imparts many other advantages to vinyl films, foams or tile; to PVA adhesives, coatings, plastisols, waxes and polishes and other products.

It will pay you to investigate the money-saving advantages of Benzoflex plasticizers. For information and samples, write Tennessee Products and Chemical Corp., Nashville 3, Tenn.

TENNESSEE PRODUCTS & CHEMICAL *Corporation*

NASHVILLE, TENNESSEE

A DIVISION OF THE CHEMICAL, PAINT AND METALLURGICAL DEPARTMENT OF MERRITT CHAPMAN & SCOTT CORPORATION

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Our large staff of highly skilled process engineers has demonstrated its ability to perform successfully in a wide variety of process areas. These specialists, backed up by our detailed design, procurement, and construction forces, have worked closely with many different industries in developing methods and processes, improving standard equipment, and providing modern, efficient facilities for profitable operations.

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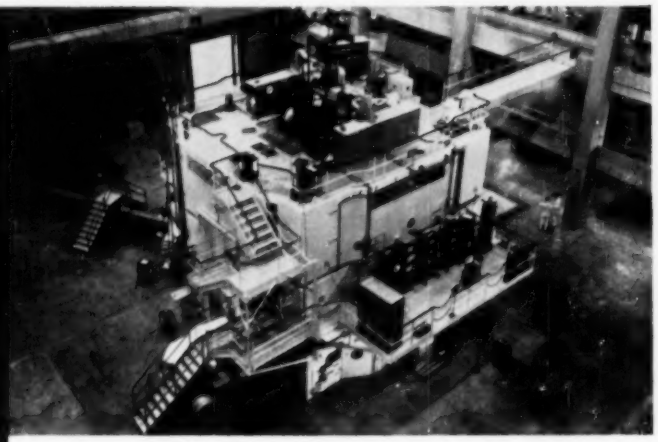
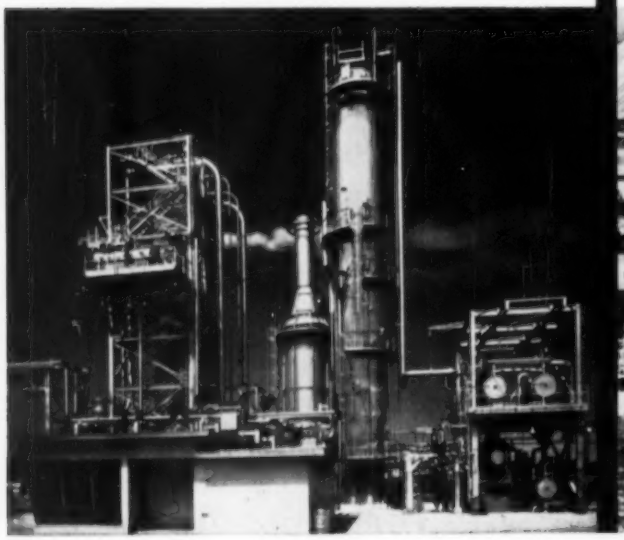
Chlor-alkali plant for Olin Mathieson Chemical Corporation
McIntosh, Alabama

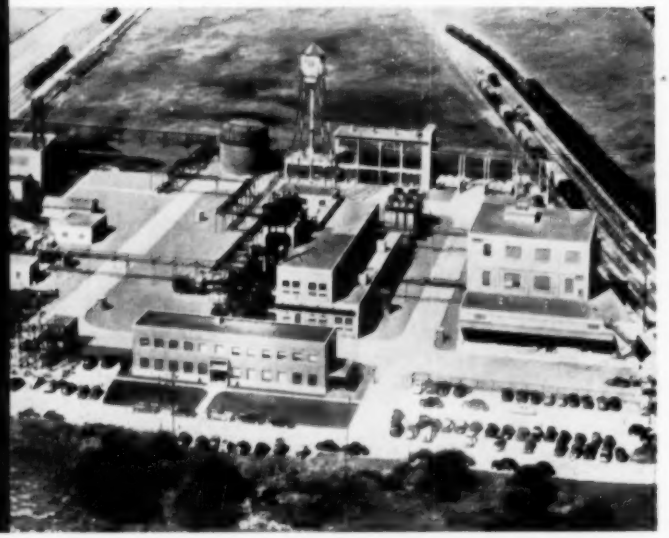


Materials testing reactor for the Atomic Energy Commission
Idaho Falls, Idaho

Petroleum refining unit for the McMurrey Refining Company
Tyler, Texas



Resin plant for Glenn L. Martin Co.
Painesville, Ohio



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RESINS and PLASTICS
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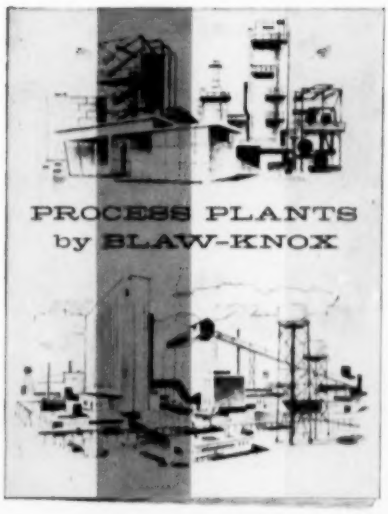
Bulletin No. 2514 outlines briefly the scope of our competence in various process industries. A copy is available on request.



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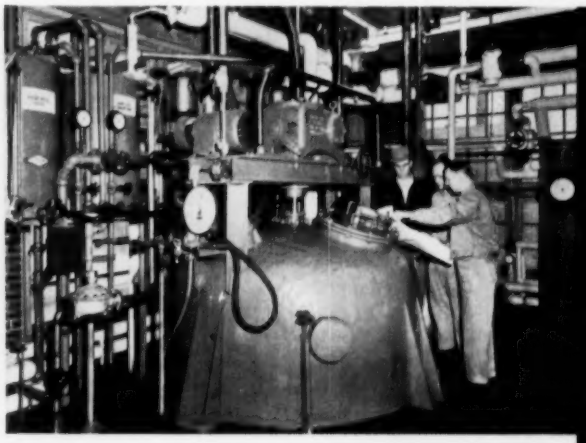
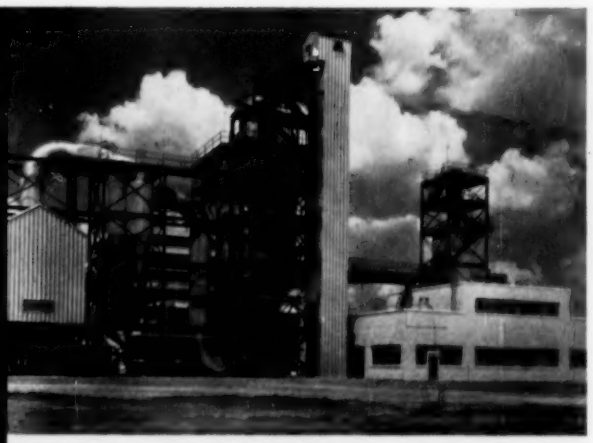


Fine-chemical facilities for Mallinckrodt Chemical Works
St. Louis, Missouri



Instant dried starch plant for Corn Products Refining Company
Corpus Christi, Texas

Fertilizer plant for Illinois Farm Supply Company
Tuscola, Illinois

Soya bean processing plant for Central Soya Company
Chattanooga, Tennessee

THERMOLITE 25, a completely new all-purpose heat and light stabilizer, permits the production of vinyl products of optical clarity and excellent heat stability. A sulfur-free organotin, it does not have the characteristic odor of sulfur-containing stabilizers. Vinyls stabilized with Thermolite 25 will not cross-stain when placed in contact with vinyls stabilized with lead or cadmium. Heat sealability and printability are outstanding. Truly all-purpose, being suitable for rigids, flexibles, plastisols and organosols, Thermolite 25 is completely compatible with all available polyvinyl chloride and copolymer resins.

Detailed information about Thermolite 25 or any of the other Thermolite organotin stabilizers is available on request.

HEADQUARTERS FOR HEAT AND LIGHT STABILIZERS

In addition to organotins, Metal & Thermit also supplies Thermolite 112, an entirely new concept in liquid barium-cadmium stabilization. Completely free from fatty acids, it eliminates many problems previously associated with barium-cadmium stabilizers.

another NEW chemical

Thermolite 25

The first ALL-PURPOSE organotin stabilizer ...does not cross-stain

THERMOLITE 25 is recommended for:

Rigid Vinyls—for optical clarity and exceptional heat and light stability.

Clear Flexibles—for unsurpassed clarity, light stability, and outdoor weathering in clear flexibles, especially vinyl garden hose—no water fogging.

Organosols and Plastisols—for good heat and light stability and the retention of clarity.

TIN & TIN CHEMICALS
CERAMIC MATERIALS
ORGANIC COATINGS
WELDING SUPPLIES
PLATING MATERIALS
METALS AND ALLOYS
HEAVY MELTING SCRAP

METAL & THERMIT CORPORATION

GENERAL OFFICES: RAHWAY, NEW JERSEY

METAL & THERMIT — UNITED CHROMIUM OF CANADA, LIMITED • REXDALE, ONT.

'ROUND-THE-CLOCK QUALITY CONTROL

...your assurance of accurate color matching in

WRENN SATURATING PAPERS

Laboratory technicians in the Wrenn paper mill work in three shifts to maintain complete quality control at every stage in the production of our saturating and other absorbent papers.

In the accompanying photo, two technicians are checking a sample piece of laminated plastic, produced on a laminating press in the Wrenn laboratory, to be certain that the color of the finished product will match the standard. The run on the paper machine will not be started until the color check has been completed.

While color matching is of extreme importance in making saturating papers for decorative applications, it is only one of the many phases of quality control in the Wrenn mill. Other physical characteristics, such as basis weight, caliper, Mullen, density and absorbency, are carefully checked and must comply with accepted standards.

Samples of Wrenn saturating papers, for both decorative and industrial applications, will be gladly submitted on request.

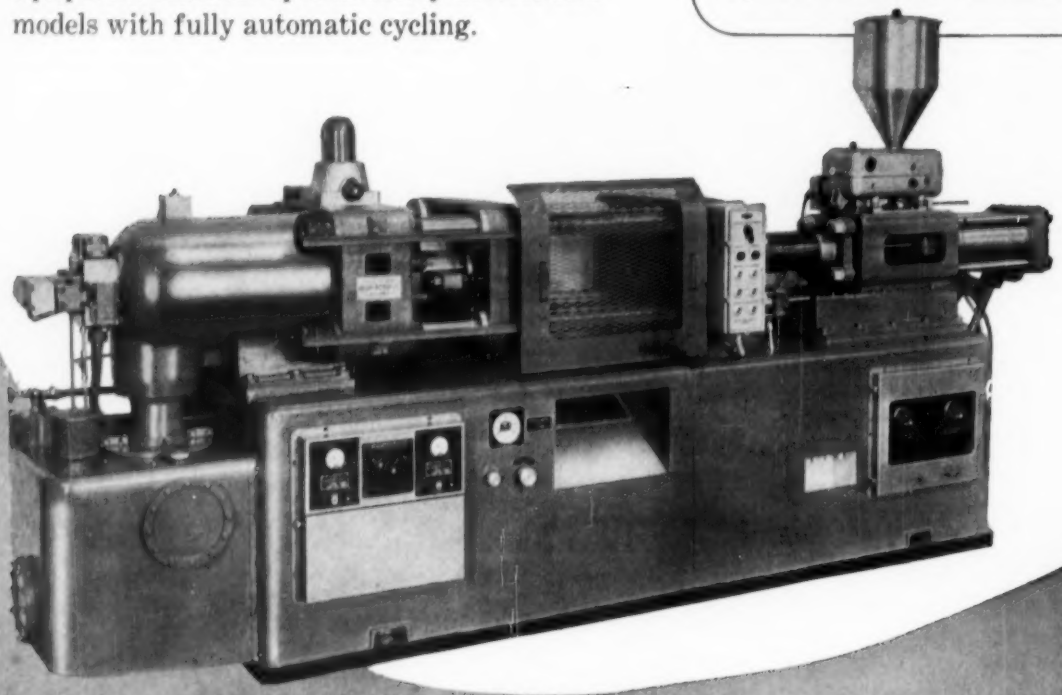
THE WRENN PAPER COMPANY

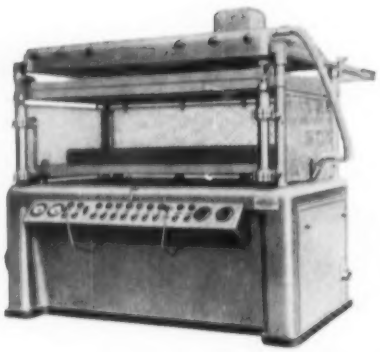
Established 1858 — **MIDDLETOWN, OHIO**

AUTOMATION

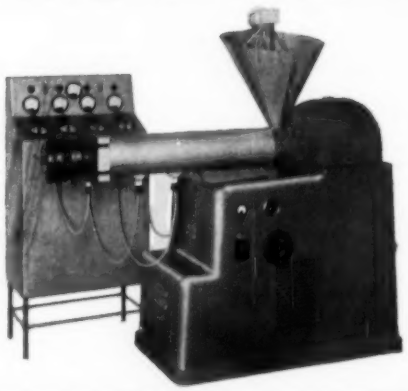
This is the age of automation and Negri Bossi automatic machines lead the way. Negri Bossi equipment features special safety devices and models with fully automatic cycling.

R. 12 F.A. Fully automatic injection press – capacity 4 to 6 oz. – fast operating cycles (8 shots a minute)





VUOTOPLAST Vacuum Forming Machines



EXTRUDERS and accessory equipment

Sole distributors:

Write for further information

U.S.A.–Acme Machinery & Manufacturing Co., Inc.
102 Grove Street, Worcester, Mass.
Phone: PLeasant 7-7747

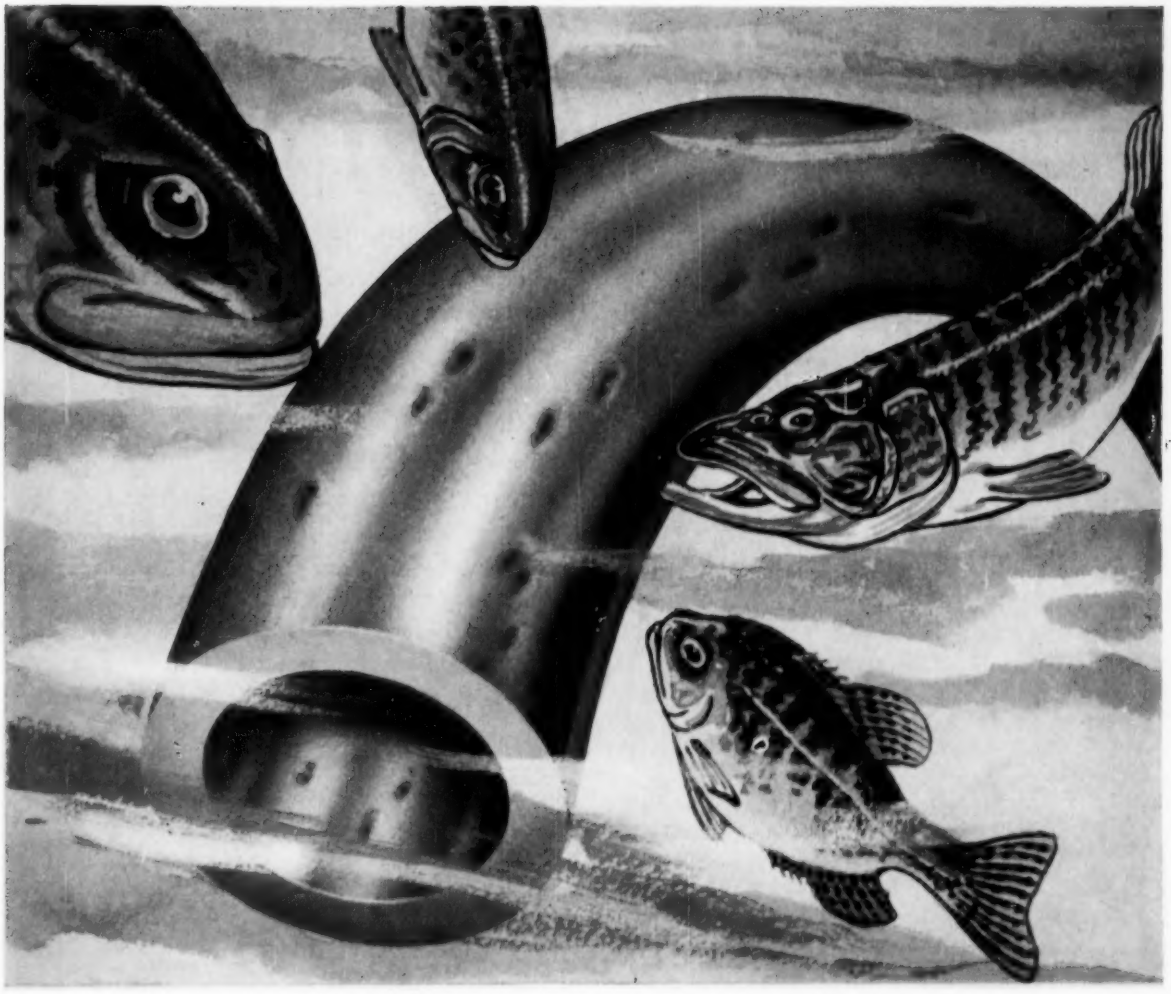
New York Office: 2315 Broadway
Phone: SUsquehanna 7-1705

Canada—Plastics Equipment & Accessories
1362 Jean Talon Est.
Montreal 35, P.Q.
Phone: CRescent 4-8274

NB&C **NEGRI BOSSI & CO., MILANO (ITALY)**

Corso Magenta, 44

Cable address: Gianimar



FISH EYES are OK for FISH

But if "FISH EYES" caused by undissolved particles ARE A PROBLEM IN YOUR PRODUCT then a look at ESCAMBIA PVC 1250 may suggest an answer. This is Escambia's new straight PVC Resin with excellent processing characteristics INCLUDING freedom from "Fish Eyes." Another plus is Improved Heat Stability with its advantages in quality control.

Other new resins include:

ESCAMBIA PVC 1225—intermediate molecular weight resin particularly adapted for supported and unsupported sheeting.

ESCAMBIA PVC 1200—low molecular weight for flexible and rigid sheeting.

For additional information about Escambia's new resins—write the address below on your letterhead—

ESCAMBIA CHEMICAL CORPORATION

261 MADISON AVENUE • NEW YORK 16, N. Y.

"Saved *hundreds* on tooling alone"

with . . .

MINI-JECTOR

TRADE MARK

PLASTIC INJECTION MOLDING MACHINES

User Claims Lowest Possible Cost in Development, Samples and Production of 1/3 oz. to 1 oz. Injection Molded Products

"For under $1,000 we were 'in business'," said manufacturer of small molded plastic parts. "Covered the cost of a MINI-JECTOR machine, mold blank, all tooling and even the initial plastic material used."

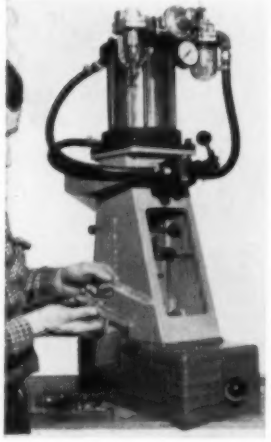
MINI-JECTOR eliminates big press "high-per-piece costs". Cuts tooling charges to a minimum. At only a *small fraction* of former time, trouble and money, you can develop an unlimited variety of small plastic items, follow up with quick thousands of market test samples, and continue with steady production. MINI-JECTOR is compact, simple to operate. Mold cap. 1/3 oz. to 1 oz. in all thermo-plastic materials, including Nylon. MINI-JECTOR saves you money at *every level—lower original cost, lower tooling cost, lower operating cost.* Pays for itself many times in *savings alone.*

MODEL 60-PC 75 "Hornet" POWER OPERATED LEVER CONTROLLED. Mold size 6" x 5" x 5⅛"

Newest of the time-tested, performance-proved MINI-JECTORS offers many exclusive features. Finest 4-tie rod construction. Cylinder and ram quickly interchangeable. Simple tooling. Parting-line sprued molds. Molds are bolted to platens, cells removable. Molded part ejection, cavity-cell push-out are part of mold. Preferred for larger area items or production runs. Simple to operate. 1/3 oz. to 1 oz. cap. Up to 30,000 p.s.i. on material. ¾ oz. model hydraulically operated (Vickers), complete, ready to produce, under $2,000.

Every day thousands of items are being developed and produced on MINI-JECTORS at *lower cost* than previous methods.

Bring your problems to Newbury! Our pilot plant can help you solve many of your difficulties in small item (up to 1 oz.) development and production.



MODEL 45 "WASP" 3/4 oz. capacity, air-operated MINI-JECTOR. Compact bench model is fast, economical. 6" air cylinder operates ram. Requires 40 to 150 pounds air pressure depending on type of plastic and product molded. Hopper cap. 4 lbs.

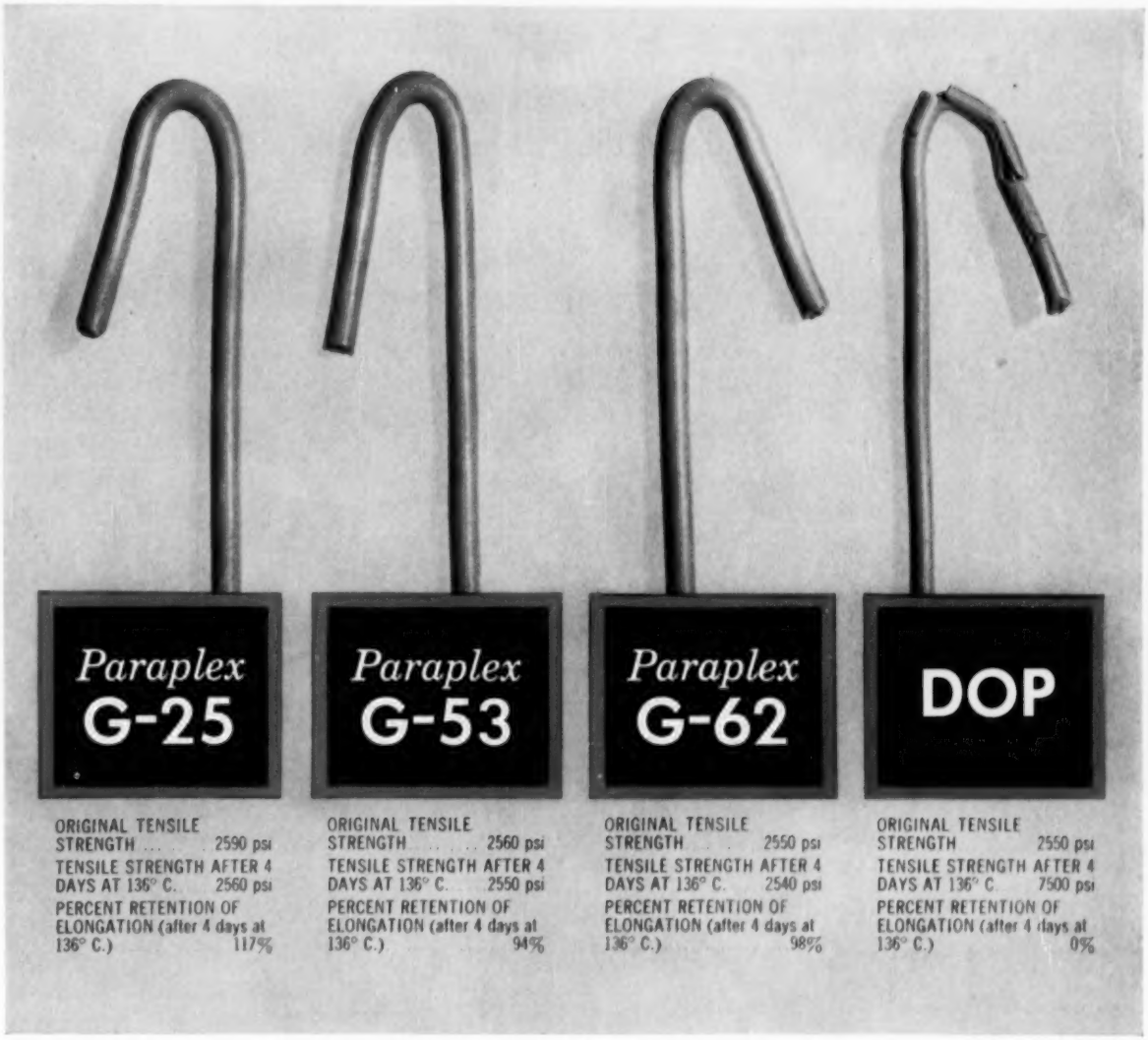
MODEL 50 "WASP"—another new MINI-JECTOR, cap. 1/3 oz. to 1 oz. at pressures up to 30,000 p.s.i. Featured for fast, precision "insert" molding with all plastics. Hydraulically operated. No special knowledge or skill required.

Write today . . . for "tell all" catalog. Shows complete MINI-JECTOR line. Learn how MINI-JECTOR adds new flexibility and economy to your plant operation.

NEWBURY INDUSTRIES, INC.

Route 87, Box 381, Newbury, Ohio

"Specializing in the Production and Development of Plastic Injection Molding Machines up to one ounce capacity."


Paraplex G-25
ORIGINAL TENSILE STRENGTH 2590 psi
TENSILE STRENGTH AFTER 4 DAYS AT 136° C. 2560 psi
PERCENT RETENTION OF ELONGATION (after 4 days at 136° C.) 117%
Paraplex G-53
ORIGINAL TENSILE STRENGTH 2560 psi
TENSILE STRENGTH AFTER 4 DAYS AT 136° C. 2550 psi
PERCENT RETENTION OF ELONGATION (after 4 days at 136° C.) 94%
Paraplex G-62
ORIGINAL TENSILE STRENGTH 2550 psi
TENSILE STRENGTH AFTER 4 DAYS AT 136° C. 2540 psi
PERCENT RETENTION OF ELONGATION (after 4 days at 136° C.) 98%
DOP
ORIGINAL TENSILE STRENGTH 2550 psi
TENSILE STRENGTH AFTER 4 DAYS AT 136° C. 7500 psi
PERCENT RETENTION OF ELONGATION (after 4 days at 136° C.) 0%

Flexing tests help you pick a plasticizer for high temperature wire insulation

If you make high-temperature wire insulation, the plasticizer is of No. 1 concern to you. The four specimens above demonstrate clearly the advantages of using PARAPLEX plasticizers for electrical insulation requiring retention of physical properties at high temperatures, as well as for non-electrical applications, such as automotive, where exposure to heat is involved in service. Notice how convincingly the samples made with PARAPLEX G-25, PARAPLEX G-53, and PARAPLEX G-62 survive a 360° bending test after aging 4 days at 136°C.; compare them with the insulation plasticized with dioctyl phthalate.

Rohm & Haas PARAPLEX polymeric plasticizers give excellent performance not only in high-temperature uses but also in general applications because of their resistance to migration, stability against heat or light, very low volatility, resistance to extraction by a variety of organic and aqueous solvents, and good electrical properties.

For more information on all Rohm & Haas plasticizers, write for *What You Should Know About* PARAPLEX *and* MONOPLEX *Plasticizers.*

PARAPLEX *and* MONOPLEX *are trade-marks, Reg. U.S. Pat. Off. and in principal foreign countries.*

Chemicals for Industry

ROHM & HAAS COMPANY

THE RESINOUS PRODUCTS DIVISION

Washington Square, Philadelphia 5, Pa.

Representatives in principal foreign countries

*TRADEMARK FOR W. R. GRACE & CO'S POLYOLEFINS

W. R. GRACE & CO.
Polymer Chemicals
DIVISION
Clifton, N. J. Baton Rouge, La.

These massive towers of steel, now reaching skyward from the rich Louisiana soil, will soon pulse with energy as we draw from raw ethylene a new, highly engineered, highly refined resin: GREX. This conversion of nature's simple wealth to a versatile plastic demands trained minds and skilled hands. We have summoned these skills on your behalf; you will discover in GREX a workable, economic solution to problems that face you today. Here is a star whose course you will surely follow.

Moulding machines thruout the plastics industry are now being installed on Air-Loc® 4·17·4

the VINYL vibration dampening mount that provides permanent precision alignment

H.P.M. 87,000 lb. injection moulding machine installed on 14 pieces of Air-Loc, each 8" x 18", spaced 47" on centers. Complete installation made without bolting or cementing machine to floor.

Air-Loc® 4·17·4 is the only Vinyl mount that gives you . . .

1. Permanent precision installation without bolting or cementing.
2. Complete resistance to oil, water, alkali, etc.
3. Easy precision shimming for quick leveling.
4. Low initial cost and no maintenance cost. (You can re-use Air-Loc mounts.)

Reduce transmitted noise and vibration from moulding machines with patented Air-Loc. Return the coupon for a free sample and complete information.

RETURN COUPON FOR A SAMPLE OF AIR-LOC AND COMPLETE INFORMATION.

AIR-LOC DIVISION CLARK, CUTLER, McDERMOTT CO., Franklin, Massachusetts

Please send a sample of Air-Loc for moulding machine installation:

Name ..... Title .....
(PLEASE PRINT)

Company .....

Address .....

City ..... Zone ..... State .....

News about

B.F.Goodrich Chemical *raw materials*

PLUG VALVE *of Geon for handling corrosive fluids demonstrates molding of complicated shapes with integral threads. At the bearing surfaces Geon is molded to another plastic.*

LOOK WHAT THEY'RE MOLDING IN GEON RIGID VINYL...

All parts shown made by Tube Turns Plastics, Inc.

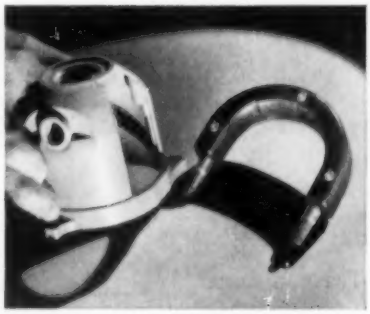
Geon polyvinyl chloride rigid compounds are recognized as outstanding materials for piping and fittings. Geon offers high impact and tensile strength, and superior resistance to oils, acids, alkalis, and most chemicals.

These same rigid compounds are being molded into many complicated shapes and parts in addition to piping components. Geon can be used in designs utilizing very thin sidewalls as well as heavy sections. Holes, studs, and threads can be made integrally. Parts weighing several pounds can be molded in one shot.

Despite design complexity, check Geon for strong, light, corrosion-resistant parts. For booklet on properties of rigid Geon compounds 8700A and 8750, write Dept. DS-5A, B. F. Goodrich Chemical Company, 3135 Euclid Avenue, Cleveland 15, Ohio. Cable address: Goodchemco. In Canada: Kitchener, Ont.

B.F.Goodrich Chemical Company
a division of The B.F.Goodrich Company

BIG FELLOWS *include piping tee and motor housing, requiring heavy cross section, chemical inertness, dimensional stability. By contrast, molding for automobile dashboard has thin section, large projected area.*



ELECTRICAL PARTS *include fractional horsepower motor housing which reduces appliance weight, and hanger band for transformer with Geon molded around metal bolt. Geon has excellent dielectric properties.*

AUTO HORN *trumpet shows complicated contours possible in rigid Geon. Note very thin walls obtained in this high-impact material. Photos courtesy Tube Turns Plastics, Inc., Louisville, Ky.*

B.F.Goodrich GEON polyvinyl materials • HYCAR American rubber and latex • GOOD-RITE chemicals and plasticizers • HARMON colors

MODERN PLASTICS

Volume 34
May 1957
Number 9

Progress report on sheet thermoforming

Giant unit used to form trailer truck linings and other parts up to 52 by 104 in. in size typifies trend toward larger forming equipment. (Photo, Strick)

New materials are opening new markets; improved forming techniques are solving long-standing problems; automation is bringing in a new era of high-speed production

Developments in materials and machinery for the thermoplastic sheet forming industry are breaking at such a rapid rate that MODERN PLASTICS Magazine's most recent survey of the field, "Plastics' junior giant," April 1955, is already out-dated. Going further back, the first over-all survey on the subject, "Shape a sheet," MODERN PLASTICS, May 1954, has within three years been made obsolete by the appearance of new equipment, new techniques, and new plastics sheet and film.

While these first two surveys could only hint at the potential in store for thermoforming—a

Supplement to the May 1957 Issue of MODERN PLASTICS Magazine

ABS POLYMER BLEND (ACRYLONITRILE—BUTADIENE—STYRENE)

MANUFACTURER	TRADE NAME	METHOD OF MANUFACTURE	THICKNESS (in.)	MAXIMUM WIDTH (in.) [1]
BOLTA PRODUCTS, INC. Div. General Tire & Rubber Co., 70 Garden St., Lawrence, Mass.	Boltaron	Calendered	0.012-1.0	48
CHICAGO MOLDED PRODUCTS CORP. 1020 N. Kolmar Ave., Chicago 51, Ill.	Campco	Extruded	0.010-0.187	40
JET SPECIALTY SALES CO. 941 N. Eastern Ave., Los Angeles 63, Calif.	Jet	Extruded	0.010-0.200	52
LUS-TRUS CORP. 884 Railroad St., Ypsilanti, Mich.	–	Extruded	0.040-0.125	46
THE MASLAND DURALEATHER CO. Amber & Willard Sts., Philadelphia, Pa.	Masland Duran	Calendered	0.010-0.250	50
O'SULLIVAN RUBBER CORP. Valley Pike, Winchester, Va.	Sullvac	Calendered	0.012-0.125	56
PLAX CORP. P.O. Box 1019, Hartford, Conn.	Polyflex	Extruded oriented	0.001-0.020	42
RARITAN PLASTICS CO. Bound Brook, N.J.	–	Extruded	0.010-0.125	50
ST. REGIS PAPER CO. Panelyte Div. 150 E. 42 St., New York, N.Y.	Panelyte	Extruded	0.010-0.187	48
SANDEE MFG. CO. 5050 W. Foster Ave., Chicago, Ill.	–	Extruded	0.015-0.187	54
SEIBERLING RUBBER CO. Plastics Div. Newcomerstown, Ohio	Seilon	Calendered & Extruded	0.010-0.187	48
SOUTHERN PLASTICS CO. 408 Pendleton St., Columbia 1, S.C.	SP-101	Extruded	0.010-0.375	52½
UNITED STATES RUBBER CO. Royalite Plastic Products 2638 N. Pulaski Rd., Chicago, Ill.	Royalite	Calendered	0.010-0.500	54

[1] Since manufacturing processes are generally continuous, sheets can be produced in almost any length and custom-cut to size. In thinner gages, generally up to 0.060 in., sheeting can be supplied in roll form. For information on sheet sizes available from stock, consult manufacturers.

Sheets based on ABS polymer blends (heretofore referred to as "styrene copolymers") are available in an unlimited opaque color range. Calendered sheets can be supplied in grain, matte, or glossy finishes; extruded sheets are generally supplied in matte or glossy finishes.

ACRYLIC [2]

ARISTOCRAT PLASTICS, INC. 23-25 Sussex Ave., Newark, N.J.	–	Cast	0.060-3.0	72
CADILLAC PLASTIC & CHEMICAL CO. 15111 Second Ave., Detroit 3, Mich.	Cadco	Extruded	0.060-0.150	49
CAST OPTICS CORP. 125 Newman St., Hackensack 1, N.J.	CO-4	Cast	0.030-0.500	48
GERING PRODUCTS, INC. N. 7 St. & Monroe Ave., Kenilworth, N.J.	Ger-Lite	Extruded	0.060-0.125	54
LARC PRODUCTS, INC. Box 327, Amsterdam, N.Y.	Larcrylic	Cast	0.060-0.375	100
MIDWEST PLASTIC PRODUCTS CO. 1801 Chicago Rd., Chicago Heights, Ill.	Midlon	Extruded	0.010-0.125	40
PLASKOLITE, INC. 222 Neilston St., Columbus, Ohio	–	Extruded	0.020-0.125	24
THE PLASTEX CO. Div. Zimmerman Co. 3232 Cleveland Ave., Columbus, Ohio	–	Extruded	0.040-0.125	38
PLASTIC GLASS CORP. 33 Ave. P, Newark, N.J.	Glacite	Cast	0.125-1.0	36
PLAX CORP. P.O. Box 1019, Hartford, Conn.	Methaflex	Extruded oriented	0.010-0.020	42
THE POLYCAST CORP. 69 Southfield Ave., Stamford, Conn.	Polycast	Cast	0.020-0.500	60
ROHM & HAAS CO. Washington Sq., Philadelphia, Pa.	Plexiglas	Cast	0.060-3.0	100
SANDEE MFG. CO. 5050 W. Foster Ave., Chicago 30, Ill.	–	Extruded	0.060-0.125	48
SOUTHERN PLASTICS CO. 408 Pendleton St., Columbia, S.C.	Soplasco	Extruded	0.010-0.250	52½
U.S. PLASTIC PRODUCTS CORP. Whitman Ave., Metuchen, N.J.	Lustrelite	Cast	0.100-0.500	40
WASCO PRODUCTS, INC. Bay State Rd., Cambridge, Mass.	Acrylite	Cast	0.125-0.250	53

[2] Figures listed in last column indicate maximum width in which sheets are available. Extruded sheets, of course, can be made continuously and custom-cut to size. Cast sheets are available in varying lengths as follows: Aristocrat, to 120 in.; Cast Optics, to 72 in.; Larc, to 120 in.; Plastic Glass, to 48 in.; Polycast, to 80 in.; Rohm & Haas, to 120 in.; U.S. Plastic, to 52 in.; Wasco Products, to 75 inches.

Acrylic sheets are available in clear transparent or in unlimited opaque, transparent, or translucent colors. Decorative sheeting (e.g. pearlized sheet, cast sheet with embedded decoration, etc.) is also available. Finish is generally glossy.

[4] Copyright 1957 by Breskin Publications, Inc., 575 Madison Ave., New York 22, N. Y. All rights reserved. This chart may not be reprinted wholly or in part without written permission from the publisher. This chart is based wholly on information supplied by the companies listed in answer to a questionnaire from MODERN PLASTICS Magazine.

CELLULOSE ACETATE

MANUFACTURER	TRADE NA
ACADIA SYNTHETIC PRODUCTS 4115 Ogden Ave., Chicago, Ill.	–
CELANESE CORP. OF AMERICA 290 Ferry St., Newark, N.J.	Lumari
CHICAGO MOLDED PRODUCTS CORP. 1020 N. Kolmar Ave., Chicago, Ill.	Campc
JOSEPH DAVIS PLASTICS CO. 450 Schuyler Ave., Arlington, N.J.	Joda
EASTMAN KODAK CO. Cellulose Products Div. 343 State St., Rochester, N.Y.	Kodapak
JET SPECIALTY SALES CO. 941 N. Eastern Ave., Los Angeles 63, Calif.	Jet
MIDWEST PLASTIC PRODUCTS CO. 1801 Chicago Rd., Chicago Heights, Ill.	Midlo
MONSANTO CHEMICAL CO. Plastics Div. Springfield, Mass.	Vuepa
NIXON NITRATION WORKS Nixon, N.J.	–
SOUTHERN PLASTICS CO. 408 Pendleton St., Columbia 1, S.C.	Soplas

CELLULOSE ACETATE BUTYRA

ACADIA SYNTHETIC PRODUCTS 4115 Ogden Ave., Chicago, Ill.	–
AUBURN BUTTON WORKS, INC. 26 McMaster Auburn, N.Y.	–
CHICAGO MOLDED PRODUCTS CORP. 1020 N. Kolmar Ave., Chicago, Ill.	Campc
EASTMAN KODAK CO. Cellulose Products Div. 343 State St., Rochester, N.Y.	Kodapak
GENERAL PLASTICS CORP. 1400 N. Washington, Marion, Ind.	Genco
JET SPECIALTY SALES CO. 941 N. Eastern Ave., Los Angeles, Calif.	Jet
KAL PLASTICS, INC. P.O. Box 236, Beaverton, Mich.	Kal
MIDWEST PLASTIC PRODUCTS CO. 1801 Chicago Rd., Chicago Heights, Ill.	Midlo
NIXON NITRATION WORKS Nixon, N.J.	–
PLASKOLITE, INC. 222 Neilston St., Columbus, Ohio	–
THE PLASTEX CO. Div. Zimmerman Co. 3232 Cleveland Ave., Columbus, Ohio	–
SANDEE MFG. CO. 5050 W. Foster Ave., Chicago 30, Ill.	–
SHOE FORM CO., INC. 26 Aurelius Ave., Auburn, N.Y.	–
SOUTHERN PLASTICS CO. 408 Pendleton St., Columbia 1, S.C.	Soplas

[3] Manufacturing processes for acetate and butyrate are custom-cut to size (with exception of Acadia, noted above) butyrate in gages generally up to 0.060 in. can be supplied directly for information on sheet sizes available from stock

Acetate and butyrate sheets are available in clear transparent, translucent, or opaque colors. Finish is generally supplied. Metallized acetate and butyrate sheets are supplied Products, 101 W. Forest Ave., Englewood, N. J.; Gomac Hy-Sil Mfg. Co., Revere, Mass.

PLASTICS MAGAZINE'S Chart of Formable Rigi

RADE NAME	METHOD OF MANUFACTURE	THICKNESS (in.)	MAXIMUM WIDTH (in.) [3]
–	Compression Molded	0.030-1.0	24 (to 24 in. long)
Lumarith	Extruded Cast	0.003-0.250 0.003-0.020	60
Campco	Extruded	0.005-0.020	22
Joda	Extruded	0.002-0.187	60
Kodapak I	Cast	0.005-0.020	40
Jet	Extruded	0.010-0.200	52
Midlon	Extruded	0.010-0.125	40
Vuepak	Extruded	0.005-0.020	60
–	Extruded	0.005-0.250	48
Soplasco	Extruded	0.010-0.200	52½

UTYRATE

–	Compression Molded	0.030-1.0	24 (to 24 in. long)
–	Extruded	0.040-0.060	21
Campco	Extruded	0.005-0.020	22
Kodapak II	Cast Extruded	0.0011-0.002 0.010-0.080	40 42
Genco	Extruded	0.010-0.125	46
Jet	Extruded	0.010-0.200	52
Kal	Extruded	0.015-0.125	72
Midlon	Extruded	0.010-0.125	40
–	Extruded	0.005-0.250	48
–	Extruded	0.020-0.125	24
–	Extruded	0.040-0.125	36
–	Extruded	0.015-0.125	48
–	Extruded	0.020-0.060	21
Soplasco	Extruded	0.010-0.375	52½

tyrate are generally continuous and sheets can be noted above). Both cast and extruded acetate and an be supplied in roll form. Contact manufacturers from stock.

clear transparent, or in an unlimited range of trans- is generally glossy, but matte finishes can also be ts are supplied by the following companies: Coating J.; Gomar Mfg. Co., 79 Paris St., Newark, N. J.; and

STYRENE AND STYRENE ALLOYS

MANUFACTURER	TRADE NAME	METHOD OF MANUFACTURE	THICKNESS (in.)	MAXIMUM WIDTH (in.) [4]
ACADIA SYNTHETIC PRODUCTS 4115 Ogden Ave., Chicago, Ill.	–	Compression Molded	0.030-1.0	24 (to 24 in. long)
ARISTOCRAT PLASTICS, INC. 23-25 Sussex Ave., Newark, N.J.	–	Extruded	0.010-0.187	50
AUBURN BUTTON WORKS, INC. 26 McMaster, Auburn, N.Y.	–	Extruded	0.010-0.187	52
CADILLAC PLASTIC & CHEMICAL CO. 15111 Second Ave., Detroit, Mich.	Cadco	Extruded Cast	0.060-0.15 0.060-1.0	49 24
CAPAC INDUSTRIES 309 S. Main St., Capac, Mich.	–	Extruded	0.060-0.150	40
CHICAGO MOLDED PRODUCTS CORP. 1020 N. Kolmar Ave., Chicago, Ill.	Campco	Extruded	0.010-0.187	40
JOSEPH DAVIS PLASTICS CO. 450 Schuyler Ave., Arlington, N.J.	Joda	Extruded	0.005-0.187	60
GENERAL AMERICAN TRANSPORTATION CORP. 135 S. LaSalle St., Chicago, Ill.	Gen	Extruded	0.040-0.187	40
GENERAL PLASTICS CORP. 1400 N. Washington, Marion, Ind.	Genco	Extruded	0.020-0.125	46
THE GILMAN BROS. CO. Gilman, Conn.	Gilco	Extruded	0.010-0.250	48
JET SPECIALTY SALES CO. 941 N. Eastern Ave., Los Angeles 63, Calif.	Jet	Extruded	0.010-0.200	52
KAL PLASTICS, INC. P.O. Box 236, Beaverton, Mich.	Kal	Extruded	0.015-0.375	72
KAYKOR INDUSTRIES, INC. Div. Kaye-Tex Mfg. Corp. Yardville, N.J.	Vyflex	Extruded	0.011-0.250	44
LURIE PLASTICS 1913 Boulevard, Colonial Heights, Va.	Luraplast	Extruded	0.010-0.187	48
LUS-TRUS CORP. 884 Railroad St., Ypsilanti, Mich.	–	Extruded	0.020-0.250	46
THE MASLAND DURALEATHER CO. Amber & Willard Sts., Philadelphia, Pa.	Masland Duran	Calendered	0.010-0.250	50
MIDWEST PLASTIC PRODUCTS CO. 1801 Chicago Rd., Chicago Heights, Ill.	Midlon	Extruded	0.010-0.125	40
NIXON NITRATION WORKS Nixon, N.J.	–	Extruded	0.005-0.250	48
PLASKOLITE, INC. 222 Neilston St., Columbus, Ohio	–	Extruded	0.020-0.125	24
THE PLASTEX CO. Div. The Zimmerman Co. 3232 Cleveland Ave., Columbus, Ohio	–	Extruded	0.040-0.125	38
PLAX CORP. P.O. Box 1019, Hartford, Conn.	Polyflex	Extruded biaxially oriented	0.001-0.020	42
PORTAGE PLASTICS CO. Portage, Wis.	Shorecrest	Extruded	0.0075-0.175	48
ST. REGIS PAPER CO. Panelyte Div. 150 E. 42nd St., New York, N.Y.	Panelyte	Extruded	0.010-0.187	48
SANDEE MFG. CO. 5050 W. Foster Ave., Chicago 30, Ill.	–	Extruded	0.015-0.187	54
SEIBERLING RUBBER CO. Plastics Div. Newcomerstown, Ohio	Seilon	Extruded & Calendered	0.010-0.187	52
SHEFFIELD PLASTICS, INC. Salisbury Rd., Sheffield, Mass.	Frost-White	Extruded	0.025-0.100	30
SOUTHERN PLASTICS CO. 408 Pendleton St., Columbia 1, S.C.	Soplasco	Extruded	0.010-0.250	52½

[4] With exception noted above (Acadia), manufacturing of styrene and styrene alloy sheet is continuous, and sheets can be custom-cut to size. Contact manufacturers directly for information on sheet sizes available from stock. Thinner gages can be supplied in roll form.

Styrene alloy sheets are available in an unlimited range of opaque colors. Clear transparent is not available. Decorated styrene sheets in a wide range of patterns, woodgrain finishes, etc., are available from Chicago Molded Products; General American Transportation Co.; Gilman Bros.; and Lurie Plastics. Metallized styrene sheet is supplied by Coating Products, 101 W. Forest Ave., Englewood, N. J.; Gomar Mfg. Co., 79 Paris St., Newark, N. J.; and Hy-Sil Mfg. Co., Revere, Mass.

GAZINE'S Chart of Formable Rigid Thermoplasti

STYRENE AND STYRENE ALLOYS

MANUFACTURER	TRADE NAME	METHOD OF MANUFACTURE	THICKNESS (in.)	MAXIMUM WIDTH (in.) [4]
ACADIA SYNTHETIC PRODUCTS 4115 Ogden Ave., Chicago, Ill.	–	Compression Molded	0.030-1.0	24 (to 24 in. long)
ARISTOCRAT PLASTICS, INC. 23-25 Sussex Ave., Newark, N.J.	–	Extruded	0.010-0.187	50
AUBURN BUTTON WORKS, INC. 26 McMaster, Auburn, N.Y.	–	Extruded	0.010-0.187	52
CADILLAC PLASTIC & CHEMICAL CO. 15111 Second Ave., Detroit, Mich.	Cadco	Extruded Cast	0.060-0.15 0.060-1.0	49 24
CAPAC INDUSTRIES 309 S. Main St., Capac, Mich.	–	Extruded	0.060-0.150	40
CHICAGO MOLDED PRODUCTS CORP. 1020 N. Kolmar Ave., Chicago, Ill.	Campco	Extruded	0.010-0.187	40
JOSEPH DAVIS PLASTICS CO. 450 Schuyler Ave., Arlington, N.J.	Joda	Extruded	0.005-0.187	60
GENERAL AMERICAN TRANSPORTATION CORP. 135 S. LaSalle St., Chicago, Ill.	Gen	Extruded	0.040-0.187	40
GENERAL PLASTICS CORP. 1400 N. Washington, Marion, Ind.	Genco	Extruded	0.020-0.125	46
THE GILMAN BROS. CO. Gilman, Conn.	Gilco	Extruded	0.010-0.250	48
JET SPECIALTY SALES CO. 941 N. Eastern Ave., Los Angeles 63, Calif.	Jet	Extruded	0.010-0.200	52
KAL PLASTICS, INC. P.O. Box 236, Beaverton, Mich.	Kal	Extruded	0.015-0.375	72
KAYKOR INDUSTRIES, INC. Div. Kaye-Tex Mfg. Corp. Yardville, N.J.	Vyflex	Extruded	0.011-0.250	44
LURIE PLASTICS 1913 Boulevard, Colonial Heights, Va.	Luraplast	Extruded	0.010-0.187	48
LUS-TRUS CORP. 884 Railroad St., Ypsilanti, Mich.	–	Extruded	0.020-0.250	46
THE MASLAND DURALEATHER CO. Amber & Willard Sts., Philadelphia, Pa.	Masland Duran	Calendered	0.010-0.250	50
MIDWEST PLASTIC PRODUCTS CO. 1801 Chicago Rd., Chicago Heights, Ill.	Midlon	Extruded	0.010-0.125	40
NIXON NITRATION WORKS Nixon, N.J.	–	Extruded	0.005-0.250	48
PLASKOLITE, INC. 222 Neilston St., Columbus, Ohio	–	Extruded	0.020-0.125	24
THE PLASTEX CO. Div. The Zimmerman Co. 3232 Cleveland Ave., Columbus, Ohio	–	Extruded	0.040-0.125	38
PLAX CORP. P.O. Box 1019, Hartford, Conn.	Polyflex	Extruded biaxially oriented	0.001-0.020	42
PORTAGE PLASTICS CO. Portage, Wis.	Shorecrest	Extruded	0.0075-0.175	48
ST. REGIS PAPER CO. Panelyte Div. 150 E. 42nd St., New York, N.Y.	Panelyte	Extruded	0.010-0.187	48
SANDEE MFG. CO. 5050 W. Foster Ave., Chicago 30, Ill.	–	Extruded	0.015-0.187	54
SEIBERLING RUBBER CO. Plastics Div. Newcomerstown, Ohio	Seilon	Extruded & Calendered	0.010-0.187	52
SHEFFIELD PLASTICS, INC. Salisbury Rd., Sheffield, Mass.	Frost-White	Extruded	0.025-0.100	30
SOUTHERN PLASTICS CO. 408 Pendleton St., Columbia 1, S.C.	Soplasco	Extruded	0.010-0.250	52½

[4] With exception noted above (Acadia), manufacturing of styrene and styrene alloy sheet is continuous, and sheets can be custom-cut to size. Contact manufacturers directly for information on sheet sizes available from stock. Thinner gages can be supplied in roll form.

Styrene alloy sheets are available in an unlimited range of opaque colors. Clear transparent is not available. Decorated styrene sheets in a wide range of patterns, woodgrain finishes, etc., are available from Chicago Molded Products; General American Transportation Co.; Gilman Bros.; and Lurie Plastics. Metallized styrene sheet is supplied by Coating Products, 101 W. Forest Ave., Englewood, N. J.; Gomar Mfg. Co., 79 Paris St., Newark, N. J.; and Hy-Sil Mfg. Co., Revere, Mass.

VINYL POLYMERS AND COPOL

MANUFACTURER	TRADE NAME
ACADIA SYNTHETIC PRODUCTS 4115 Ogden Ave., Chicago, Ill.	–
AMERICAN AGILE CORP. P.O. Box 168, Bedford, Ohio	Agilide
BAKELITE CO. Div. of Union Carbide & Carbon Corp. 30 E. 42nd St., New York 17, N.Y.	Bakelite
BOLTA PRODUCTS, INC. Div. General Tire & Rubber Co. 70 Garden St., Lawrence, Mass.	Boltaron
COLUMBUS COATED FABRICS CORP. Seventh & Grant Aves., Columbus 16, Ohio	Col-o-vin
CHARLES CROWL CO. 11667 McBean Drive, El Monte, Calif.	Fireban (vinyl-styrene alloy)
FIRESTONE PLASTICS CO. P.O. Box 690, Pottstown, Pa.	Velon
B. F. GOODRICH CO. Plastics Div. Westview, Marietta, Ohio	Koroseal
KAYKOR INDUSTRIES, INC. Div. of Kaye-Tex Mfg. Corp. 4407 S. Broad St., Yardville, N.J.	Vyflex
THE MASLAND DURALEATHER CO. Amber & Willard Sts., Philadelphia, Pa.	Masland Duran
MONSANTO CHEMICAL CO. Plastics Div. Springfield 2, Mass.	Ultron
NIXON NITRATION WORKS Nixon, N.J.	–
RESIN INDUSTRIES, INC. Sub. of The Borden Co. 315 Olive St., Santa Barbara, Calif.	Resinite
RESPRO, INC. Div. General Tire & Rubber Co. 530 Wellington Ave., Cranston, R.I.	Resproid
SEIBERLING RUBBER CO. Plastics Div. Newcomerstown, Ohio	Seilon
SOUTHERN PLASTICS CO. 408 Pendleton St., Columbia 1, S.C.	Soplasco

[5] The calendering technique by which the majority of vinyl continuous and sheets can be custom-cut to size. Contact man sheet sizes available from stock. Little sheet has thus far be being done in this direction. Cast vinyl, which is generally s ble in roll form in thicknesses from 0.001 in. to 0.007 in. from

Sheets based on vinyl are available in clear transparent or and opaque colors. Finishes ranging from matte to press-polish

Property	*ASTM Test No.*
Specific gravity	792-47T
Tensile strength, p.s.i.	638-49T
Flexural strength, p.s.i.	790-49T
Flexural modulus, p.s.i. X 10^5	790-49T
Izod impact, ft-lb./in. of notch @ 72° F.	256-47T
Izod impact, ft-lb./in. of notch @ −20° F.	256-47T
Heat distortion, °F. @ 66 p.s.i.	648-45T
Heat distortion, °F. @ 264 p.s.i.	648-45T
Rockwell hardness, R scale	785-48T
Moisture absorption, % 24 hr.	570-42
Dielectric strength, short time v./mil	D149-44
Dielectric constant @ 10^6 cy.	D150-47
U.V. resistance	

† Courtesy MODERN PLASTICS Encyclopedia Issue, Sep

stic Sheets*

OPOLYMERS

NAME	METHOD OF MANUFACTURE	THICKNESS (in.)	MAXIMUM WIDTH (in.) [5]
-	Compression Molded	0.030-1.0	24 (to 24 in. long)
lide	Calendered	0.0625-1.0	48
elite	Calendered	0.050-0.250	51½
aron	Calendered	0.012-1.0	48
o-vin	Calendered	0.008-0.030	54
eban styrene loy)	Calendered	0.031-0.375	37
lon	Calendered	0.005-0.035	54
oseal	Calendered	0.010-2.0	48
flex	Calendered	0.005-1.0	54
sland ran	Calendered	0.010-0.250	50
tron	Calendered	0.010-0.020	75
–	Calendered	0.005-0.250	48
inite	Calendered	0.009-0.020	48
proid	Calendered	0.010-0.025	54
ilon	Calendered	0.005-0.060	52
lasco	Extruded	0.035-0.087	30

of vinyl sheets listed above are produced is ntact manufacturers directly for information on us far been extruded but considerable work is nerally supplied in very thin gages, is availa- in. from Bakelite Co.

arent or in unlimited transparent, translucent, ss-polished are also available.

POLYETHYLENE

MANUFACTURER	TRADE NAME	METHOD OF MANUFACTURE	THICKNESS (in.)	MAXIMUM WIDTH (in.) [6]
ACADIA SYNTHETIC PRODUCTS 4115 Ogden Ave., Chicago, Ill.	–	Compression Molded	0.030-1.0	24 (to 24 in. long)
ALLIED RESINOUS PRODUCTS, INC. 525 W. Adams St., Conneaut, Ohio	Resinol	Extruded	0.031-2.0	36
AMERICAN AGILE CORP. P.O. Box 168, Bedford, Ohio	Agilene	Extruded	0.0625-1.0	48
AUBURN BUTTON WORKS, INC. 26 McMaster, Auburn, N.Y.	–	Extruded	0.020-0.187	52
CADILLAC PLASTIC & CHEMICAL CO. 15111 Second Ave., Detroit 3, Mich.	Cadco	Extruded	0.060-0.250	49
CHICAGO MOLDED PRODUCTS CORP. 1020 N. Kolmar Ave., Chicago 51, Ill.	Campco	Extruded	0.030-0.125	40
GERING PRODUCTS INC. N. 7th St. & Monroe Ave., Kenilworth, N.J.	–	Extruded	0.015-0.125	24
GILMAN BROS. CO. Gilman, Conn.	Gilco	Extruded	0.010-0.250	48
JET SPECIALTY SALES CO. 941 N. Eastern Ave., Los Angeles 63, Calif.	Jet	Extruded	0.010-0.200	52
KAL PLASTICS, INC. P.O. Box 236, Beaverton, Mich.	Kal	Extruded	0.015-0.250	72
LURIE PLASTICS 1913 Boulevard, Colonial Heights, Va.	Luraplast	Extruded	0.010-0.187	48
LUS-TRUS CORP. 884 Railroad St., Ypsilanti, Mich.	–	Extruded	0.040-0.125	46
MIDWEST PLASTIC PRODUCTS CO. 1801 Chicago Rd., Chicago Heights, Ill.	Midlon	Extruded	0.010-0.125	40
PLICOSE MFG. CORP. 71-77 Box St., Brooklyn 22, N.Y.	Plicose	Extruded	0.020	48
ST. REGIS PAPER CO. Panelyte Div. 150 E. 42nd St., New York, N.Y.	Panelyte	Extruded	0.010-0.187	48
SANDEE MFG. CO. 5050 W. Foster Ave., Chicago 30, Ill.	–	Extruded	0.015-0.187	54
SEIBERLING RUBBER CO. Plastics Div. Newcomerstown, Ohio	Seilon	Extruded	0.010-0.250	48
SOUTHERN PLASTICS CO. 408 Pendleton St., Columbia 1, S.C.	Soplasco	Extruded	0.007-0.187	52½

[6] Since polyethylene sheet is extruded continuously (with exception of Acadia, noted above) sheets can be custom-cut to size. Contact manufacturers directly for information on sheet sizes available from stock. Thinner gages are available in roll form.

Information listed above applies to branched polyethylene materials. Most manufacturers will also be able to supply linear polyethylene sheet when it is available in larger quantities. Polyethylene sheet is supplied in an unlimited range of translucent and opaque colors. Finishes range from glossy to matte.

Physical properties of formable rigid sheets [1]

M No.	*Rigid vinyl copolymer*	*Rigid PVC Type I*	*Rigid PVC Type II*	*ABS Polymer*	*High impact styrene*	*Cellulose acetate*	*Cellulose acetate butyrate*	*Polymethyl meth-acrylate*	*Polyethylene branched type*	*Polyethylene linear type*
7T	1.37-1.45	1.4	1.35	1.01-1.09	1.04-1.06	1.30	1.20	1.19	0.92	0.93-0.96
9T	7000-9000	8500	5700	4000-4500	2200-3400	6500	5550	9000	2000	3000-5000
9T	12000	12000	10000	5000-6800	5500-6500	7500	6200	16000	1700-2000	
9T	4.5-5.0	5.0		1.8-2.4	2.5-3.0	2.8	1.35	4.25	0.3	0.75-1.4
7T	0.5-0.75	0.8	15	5-10	0.8-6.0	2.8	2.1	0.4	18	1-5
7T	0.2	0.2	1.5	0.5-2.5	0.2-2.5	0.8	1.0			
5T		166	158	180-190	180-190	179	176	221	120	140-155
5T	142-153	162	155	170-180	155-180	162	152	210		
8T	–	110	–	85-90	55-100	97	1.04	M-90	11	35-50
2	0.08	0.05	0.10	0.3-0.5	0.1-0.5	4	1.6	0.3	0.01-0.02	
4	425	700-1000		390	400-500	1100		500	460	500-600
7	3.0	3.0-3.5		2.93-4.35	2.65	4.4		2.5	2.3	2.35
	Good	Fair	Fair	Fair	Fair	Good	Good	Good	Fair	

ssue, Sept. 1956

Rugged housing for soda dispenser (left) is formed of butyrate sheet in three parts (right). Front grille is of clear sheet and is metallized on the reverse surface. (Photos, Eastman Chemical)

potential that can mean a market for 175 to 200 million lb. of plastics sheeting by 1965—recent events now make it possible to anticipate the future more exactly. As a guide to what is happening in this fast-moving field, MODERN PLASTICS Magazine presents this progress report.

Progress in materials

The "big five" in formable plastics sheeting —styrene alloys and polymer blends, acrylic, vinyl and vinyl copolymers, cellulose acetate, and cellulose acetate butyrate—still account for a major share of the forming business. High-impact styrene sheet, with 1956 sales totaling between 35 and 45 million lb., leads the pack, with approximately 75% going into refrigerator applications. Acrylic, with principal markets in signs and displays and lighting applications, stands second with a total of about 20 million lb. sold for formed products in 1956.

Of significance to the future are the results of research activities by suppliers of the "big five" materials which have given rise to special formulations aimed at *specific* phases of the lush formed plastics market.

Sheffield Plastics, Inc., Sheffield, Mass., for example, with an eye on the light diffuser market, has come up with a new type of modified styrene sheet impregnated on its top surface with an ultra-violet light absorbent material that improves light stability.

Celanese Corp. recently introduced an acetate sheet formula which has been approved by F.D.A. for packaging foods.

Charles Crowl Co.'s Fireban fire-resistant styrene-vinyl alloy sheet shows promise in the fields of transportation, luggage, and tote trays. (See "Thermoformable, flame resistant," MODERN PLASTICS, March 1957.)

Chicago Molded Products Corp.'s Registrite modified styrene sheet, with its uniform strain pattern, has been designed specifically to meet the pre-printing requirements of the display, toy, and other industries.

Decorative effects possible

Decorated plastics sheeting has opened new areas of application in displays, packaging, housewares, and luggage. Styrene sheet decorated with a reverse-printed overlay laminated to its face has already made its mark. (See "Reverse-printed overlays," MODERN PLASTICS, Sept. 1956.) Gilman Bros., Gilman, Conn., recently introduced a pre-flocked styrene sheet that can be formed (without destroying the

Approximate prices of thermoformable plastics sheet

(per 1000 square inches)

	0.005 in.	0.010 in.	0.020 in.	0.080 in.	0.125 in.
Rigid vinyl copolymer	$ .19	$ .35	$ .65	—	—
Cellulose acetate butyrate	.22	.44	.85	3.58	—
Cellulose acetate, clear	.19	.39	.77	—	—
Biaxially oriented polystyrene	.15	.28	.58	—	—
Hi-impact styrene	—	—	.54	1.61	2.57
Acrylic	—	—	—	4.34	4.48
ABS polymer, press laminated, random core	—	—	1.12	3.85	5.88
Polyethylene (branched)	—	—	.37	2.11	2.94

*As of March 1957. Figures given are approximations based on information from major material suppliers, and do not reflect the price ranges in the categories listed. Prices are given only for those thicknesses commonly used in thermoforming.

Lawn ornament is formed in two halves of styrene. Sombrero, which doubles as bird bath, is formed separately. (Photo, Rosenberg Bros.)

With this article will be found, inserted loose, a chart listing principal *manufacturers* of the rigid thermoplastic sheet most commonly used by sheet formers. Distributors and jobbers and processors and laminators of plastic sheet are *not* listed. The chart also includes a summary of physical and chemical properties of the various sheet materials.

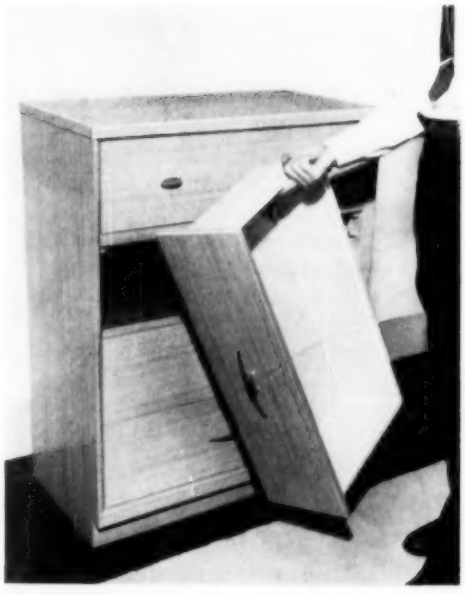
Extra copies of the chart will be available from MODERN PLASTICS Magazine for a limited time.

flocking) into luxury-type packages and displays. Embossed polyethylene and styrene sheets that can be formed into luggage or housings (again without smoothing out the grain pattern) are being researched. Wasco Products, Inc., Cambridge, Mass., has a cast acrylic sheet in which leaves, fabrics, butterflies, or other decorative fillers have been embedded and which can be formed into household items, etc.

Polyethylene—branched and linear

Important also to the future of formable plastics sheet are the new materials that have sprung up in the past two years to join the "big five."

Branched polyethylene sheet, biggest of these newer materials, started slowly but is now moving along, having hit a total sales figure of prob-



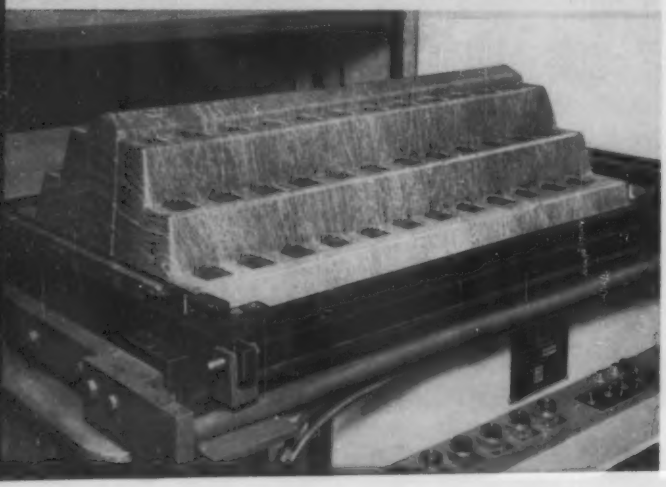
Large-volume market is predicted for formed one-piece styrene drawers. Furniture manufacturers can face drawers with appropriate wood panel. (Photo, St. Regis)

Contoured acetate blister package has turned-in edges which permit blister to slide off cardboard backing when glove is to be inspected. (Photo, Celanese)

ably over 5 million lb. in 1956. Refinements in forming techniques and the recent announcements by two suppliers of improved extrusion grade resins aimed specifically at the sheet forming market will probably push polyethylene sheet forward at a faster rate in the future. At present, food packaging—particularly formed semi-rigid containers for frozen foods, ice cream, cottage cheese, etc.—stands out as a major outlet.

Most of the other promising new plastics sheets fall under the category of "it's too early to tell, but . . ." Heading this list are the new linear polyethylene materials. Nearly every sheet former has sample applications formed of linear polyethylene, designed to take advantage of the material's stiffness, chemical resistance, boilability, low-temperature impact strength, and low vapor permeability. Potential applications under study include light diffusers, trailer truck linings, closure caps, housewares items, pharmaceutical and cosmetic containers, housings, displays, trays, and frozen food packages.

Classroom globe, formed in two halves of styrene sheet, can be colored by students. (Photo, Plaxall; Geo-Physical Maps)



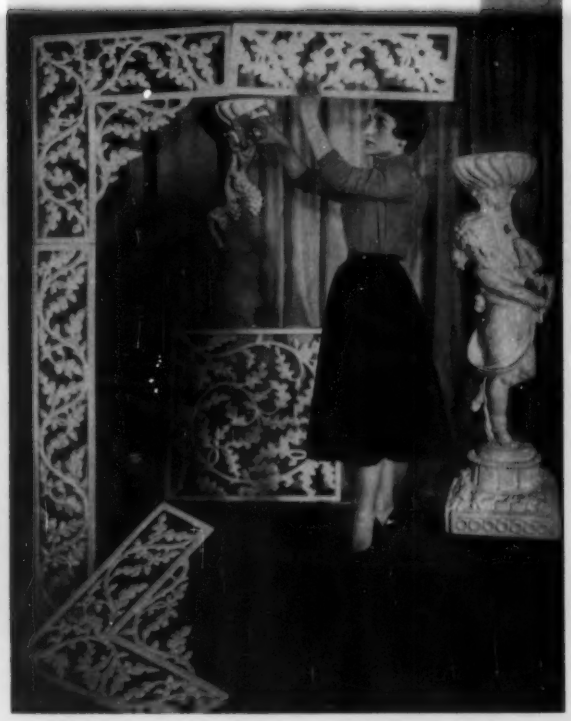
Sheet styrene display (top) has recesses for holding boxes of lingerie. Complex unit, 24 by 36 by 10 in., is formed in one piece (below) of decorated sheet. (Photos: top, Chicago Molded; bottom, Newhart)

Principal drawback to the material seems to be the difficulty of forming it—but this can be overcome by correct forming techniques. Hercules, for example, recommends the following procedures when working with its Hi-Fax material: longer heating cycles, elevated heater temperatures, or sandwich-type heaters (sheet placed between two heaters) to overcome low heat transfer rate; cooling the formed piece to a crystalline state before releasing vacuum; and, in light of the material's shrinkage rate of 0.020 to 0.040 in./in., changing mold dimensions to hold established design dimensions.

Once linear polyethylene becomes available in commercial quantities, estimates are that the poundage of sheet consumed by the forming industry can go to about 4 million lb. by 1960—and close to 8 million by 1965.

Other new materials

Most of the other new materials—and this includes Mylar polyester film, oriented styrene, nylon, and the laminates—can be formed on existing equipment but most manufacturers seem to feel that they will not reach their full potential until machines are available that take into consideration their unique properties.



Decorative grille work used in the display field typifies exacting detail which can be achieved through the use of latest forming techniques. (Photo, Stensgaard)

Three-dimensional sign is turned out by direct pressure method using male and female dies. (Photo, Timely Products)

A number of formed Mylar applications are already in the works. Distler Engineering Co., Philadelphia, Pa., for example, forms Mylar into liners and diaphragms for aerosol containers and diaphragms for radio speakers and Sillocks-Miller, Maplewood, N.J., forms it into electronic components.

Oriented styrene for packages, container lids, etc., was given a big boost by the development of a technique for trapped-sheet forming the material. (See "Trapped-sheet forming," MODERN PLASTICS, March 1956.)

A good deal of work on formed nylon has been done in Europe where such applications as a vacuum formed sardine can have been turned out.

Leaders in the "laminates" group are oriented styrene-to-styrene and Mylar polyester film-to-styrene. The first material gives a glossy surfaced sheet which is ideal for refrigerator and appliance applications; the second provides a highly abrasion-resistant sheet that should find wide use in furniture, appliances, and wall coverings. Other laminates are also being investigated. One supplier is even talking of a nylon-vinyl laminate which would take advantage of the outstanding properties of nylon while keeping the price of the sheet competitive with other materials.

Small items, such as refills for ball-point pens, can be economically skin-packaged in cast vinyl film. (Photo, Bakelite)

Progress in machinery

Diversity in equipment to meet the divergent interests of the wide range of industries involved in thermoplastic sheet forming is the new goal for the forming machinery manufacturers. For example, Auto-Vac Co., Bridgeport, Conn., has already supplemented its line of general-purpose straight vacuum and drape forming machines with a special roll-fed skin-packaging machine, a plug forming machine, and, most recently, a combination vacuum and air-pressure forming machine aimed at handling some of the more difficult-to-form sheets. Similarly, Emhart Mfg. Co., Hart- (*To page* 218)

Adhesive in film form

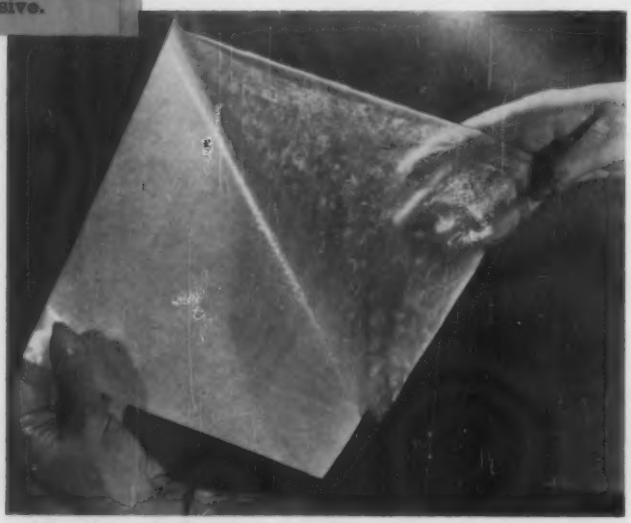
New pressure-sensitive product is versatile, easy to use

A pressure-sensitive adhesive furnished to the user in the form of a film that is tacky on both sides, "dry," and ready to use, instead of a conventional, semi-liquid formulation, has been put on the market by Rubber & Asbestos Corp., Bloomfield, N. J.

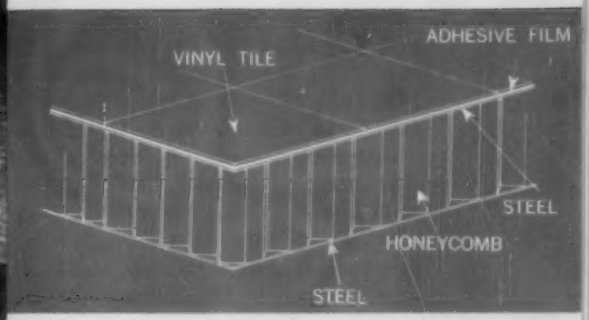
It is so easy to use that a great many articles to which pressure-sensitive adhesives could not be applied because of their liquid composition, or because of the need for elaborate coating equipment, highly trained personnel, fire hazards, etc., now can be made available, precoated with adhesive, by the manufacturer of the product.

This should substantially change marketing procedures in a great many industries. For example, use of the new film adhesive can drastically simplify the installation of vinyl floor tile. The floor covering manufacturer can now market vinyl floor tile with the film pre-applied to the back. The user should simply strip off a protective paper from the adhesive, lay the tile

Peel off release paper from bottom to uncover film adhesive.



Essentially transparent adhesive film being pulled off release paper consists of a paper carrier saturated and coated on both sides with pressure-sensitive adhesive. (Photos, Rubber and Asbestos Corp.)



Vinyl tiles in electronic computer floor installation are bonded to removable honeycomb sandwich panels by new film. Diagram shows construction details

on the floor, and step on it to give enough pressure for adhesion. This solid film adhesive is not to be confused with conventional masking or adhesive tapes that are backed with cellulose, paper, or fabric. It is a translucent, solid glue in which the glue line thickness is *entirely* that of the adhesive alone.

Sticks to almost anything

The new adhesive has a particular affinity for plastics and it will even stick to Teflon, a material that resists sticking to the highest degree. Other plastics for which it has a hold-tight affinity are polyethylene; polystyrene; cellulose acetate; both plasticized and unplasticized vinyl chloride; polyester film, metallized and plain; cellulose triacetate; and saran-coated cellophane.

Tradename of the new adhesive film is Tackmaster. It is described chemically as a formulated polyvinyl ether composition with outstanding retention of original adhesion values even after prolonged exposure to heat, oxidation, and light.

The new adhesive product consists of a lightweight, porous, essentially transparent paper carrier which has been saturated and coated on both sides with a clear, aggressive, super-aging pressure-sensitive adhesive. The film, therefore, is tacky on both sides.

For ease of handling, the film is wound up with a silicone-coated release paper by the manufacturer. The adhesive film is protected on one side only, leaving the second side free for swift, easy combining with other films, foams, cloths, and other surfaces without the need for the elaborate equipment and trained personnel demanded for efficient applications of liquid adhesives of the same type. The new film also eliminates costly waiting (drying time), expensive equipment for drying as well as for coating, and various fire hazards.

The new film adhesive has been specifically developed for use on relatively flat surfaces where intimate and complete contact can be made between the film and the materials to be bonded. As with most liquid pressure-sensitive adhesives, the resultant bond will not sustain severe creep stresses or elevated temperatures, but does offer excellent general adhesion.

Results of tests

For general guidance, adhesion values (which, of course, will vary depending upon the materials to which the adhesive film is applied) have been indicated by the manufacturer to be a minimum of 44 oz./in. when measured after seven days on stainless steel at room temperature, pulled at 12 in./minute. A series of aging tests, as standard with the pressure-sensitive adhesive industry, revealed no apparent change in the properties of the film adhesive.

A considerable amount of detailed test data exists on the use of Tackmaster in bonding primed vinyl-metallized Mylar laminations to high-impact styrene copolymers. Tests were conducted both on flat material and on deep-embossed patterned material where initial bond area strengths of the film to the vinyl were influenced by poor contact.

Tests were conducted with the bonds sub-

jected to the following conditions: 1 hr. at 100° F., peel at 100° F.; 7 days at 100° F., peel at 100° F.; 7 days at 150° F., peel at 75° F.; 1 hr. at 32° F., peel at 32°.; 1 hr. at 0° F., peel at 0° F.; room temperature overnight; and room temperature 7 days. No loss in initial tack, no delamination, and no discernible change in bond strength were observed.

In the tests mentioned above, it was observed that the adhesion to various surfaces was well over 40 oz./inch. The adhesion to the release paper is on the order of 6 oz./inch.

This effectively means that when the film is applied to a surface which is clean and dry, and is rolled with a firm roller (so that it develops its full adhesion over its entire area) about 1/7 of the stripping strength of the bond will be adequate for removal of the release paper.

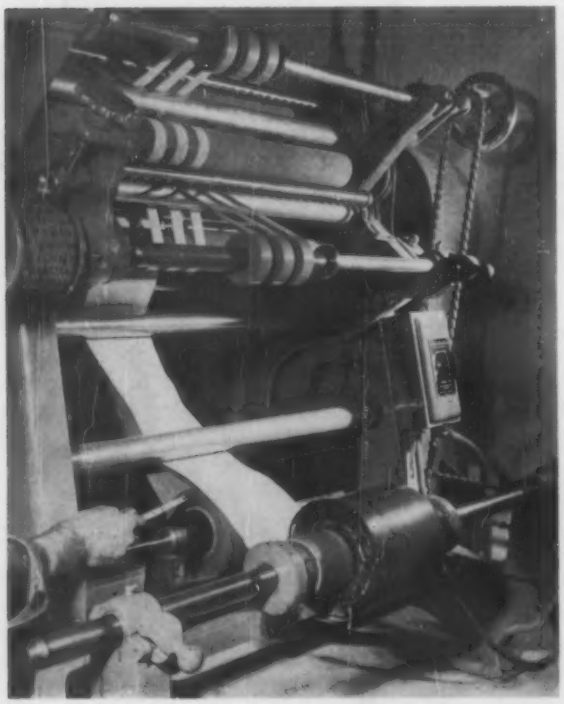
Guide to use of film

It is obvious that a factor of extreme importance lies in the nature of the material to which the new pressure-sensitive film adhesive is applied. Ease of withdrawing the release paper from the film is directly related to the flexibility and to the surface conditions of the material being bonded, since it is these factors which influence the strength of the bonds.

As a general guide: a) the firmer the material to which it is applied, b) the cleaner and drier the material, c) the more complete the contact with the film, and d) the firmer the pressure in combining, the stronger the final bond will be and the easier it will be to pull off the release paper.

One practical application involves the bonding of vinyl tile, backed with the new adhesive film, to the steel panel "faces" of Pedestal Panel Floor, an aluminum honeycomb core "sandwich" manufactured by Bel Air Industries, Bel Air, Md. These removable floor panels are used in electronic computer installations where maximum strength must be coupled with minimum weight.

For work of this type, where either a semi-rigid or a flexible materials must (*To page* 233)



Teflon tape is combined with film adhesive and slit in production of "bondable" Teflon. Operator points at roll of film, one side of which is protected with release paper. For typical application, see photo below

High-voltage wires are spliced with bondable Teflon; paper backing is stripped off as tape is applied. Advantages of tape are zero moisture absorption, good insulation, long life, ease of application

COLOR

for phenolics

Thanks to new epoxy coatings, the work-horse takes on beauty

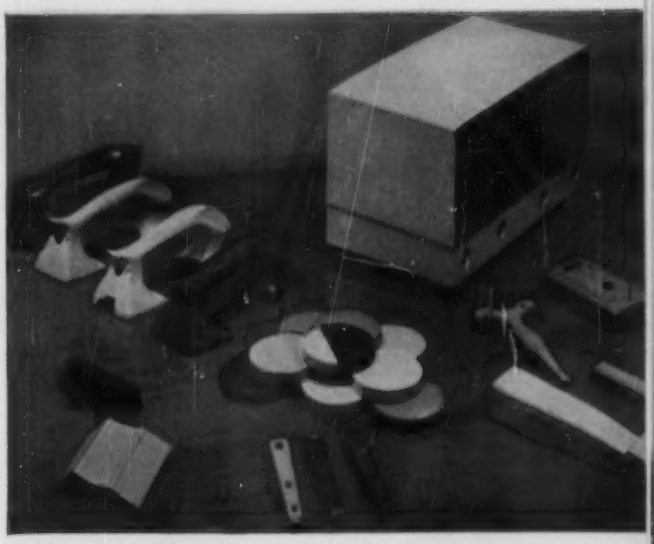
With all its cost economies, its easy moldability, dimensional stability, and insulating properties, and in spite of a variety of part strengths available through a wide range of fillers and reinforcements, phenolic molding material has always suffered seriously from its lack of sunlight resistance and from being limited to dark colors such as black, brown, and maroon.

This shortcoming has lost to phenolics many important markets during the past few years when color has been a key to product merchandising of all kinds.

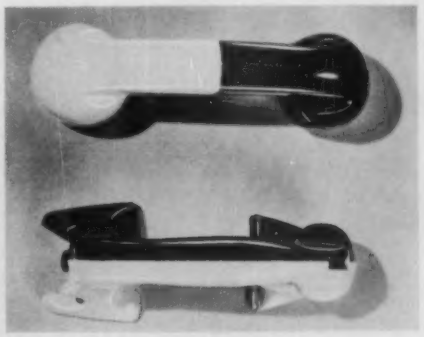
Many attempts have been made to overcome the problem. Multi-coat enamel applications with primers have been used; metals have been added to the molding material to make it platable where electrical insulation was not a factor; much experimentation has been done on light-colored phenolic alloy development.

Now, using epoxy resins, a line of industrial finishes for permanent application to even the glossiest phenolic surface has been developed.

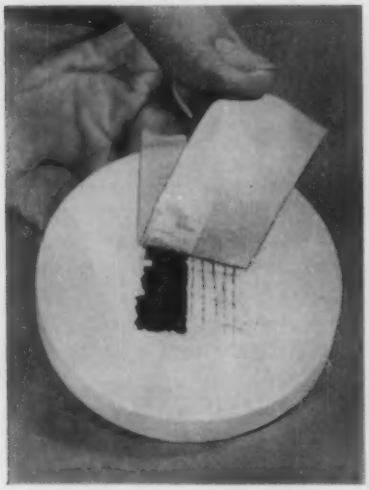
The new finishes are available in an almost



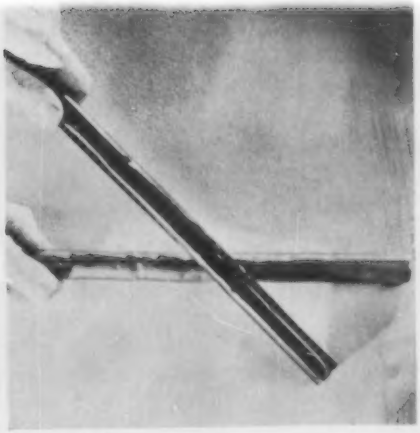
Molded phenolic parts can be given almost limitless color range through use of epoxy enamel. (Four-color plates, Bakelite Co.)



Half of black phenolic telephone handset and iron handle are coated with light-colored epoxy finish



In adhesion test, tape strips off conventional enamel (left); cross-hatched epoxy enamel stays in place



Pipes coated with new epoxy enamel have been struck together till dented—but the finish remains undamaged

Operator (left) uses spray gun to give molded phenolic iron handles a coating of light-colored epoxy enamel. (Photos, Bakelite)

Safety helmets are made of phenolic laminate, then epoxy-coated in bright, high-visibility colors. (Four-color plates, Bakelite)

limitless range of colors with surfaces all the way from dead flat to high gloss. They can be applied in a single coat with no primer for drying by air, by forced drying, or by baking.

Combine color and economy

To phenolic moldings they bring not only color but economy, since applied cost is only about one cent per square foot. They are declared not to chip, to have excellent heat resistance, and to be resistant to common kitchen fats, chemicals, perspiration, and dirt.

For the molder these finishes obviate the cleaning of machines for change of color. They virtually eliminate part rejection through mottle or color contamination. They minimize inventory problems. They offer greater flexibility in small runs.

Air-dried finished articles may be handled in 2 hr. and lightly packed in 24 hours. Articles force-dried at 140° F. for 10 min. may be handled immediately and may be lightly packed in 30 minutes. Articles on which the finish is baked for 1 hr. at 250° F. can be handled immediately and will stand severe packing upon removal from the oven.

Versions of these new finishes are also available for applying over polished metal surfaces, over reinforced polyester and epoxy moldings, over wood (sealers and primers are used here), over high-pressure laminates, over urea and melamine, and even over hard rubber.

Credits: Rexclad epoxy enamels by Rexton Finishes Inc., Irvington, N. J., based on Bakelite epoxy resins.

Polyethylene film in construction

Potential is over 100 million pounds per year but problems are still present

*By William Schopflin**

In the past two years a number of new uses for polyethylene film have been developed in the construction industry. Roll after roll of film ranging from 1 to 6 mils is being used as a moisture barrier in a multitude of applications for highway, home, and building construction. These are all still relatively new or still in the development stage.

Consumption of film in these applications has grown from practically nothing two years ago to an estimated 15 million lb. last year. The ultimate potential is possibly in excess of 100 million lb. annually, with consumption probably reaching 50 to 60 million lb./year within the next two or three years.

The growth in construction markets has not come about without problems—primarily of distribution. These problems are still present, but the situation is rapidly improving.

Probably the key to polyethylene's meteoric increase in the construction industry is that here the film is being applied for already accepted end-uses. Contractors have been accustomed to using other materials as moisture barriers and protective coverings. Now they have an opportunity to use a new material with more promising properties at a lower price. A million and one-half tons of construction paper have been used annually for such purposes for the past several years. A good share of this market is available to polyethylene.

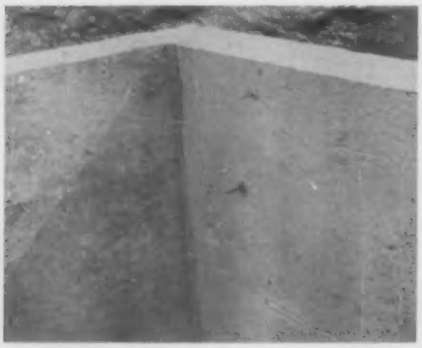
The film, both natural and black, slated for

*General sales manager plastics, Spencer Chemical Co.

Polyethylene film used as moisture protection in slab construction. Tear resistance of film permits easy fitting around electrical conduits and plumbing pipe. When film is laid during strong winds, wooden boards are used to hold it in position

Crawl space can be moistureproofed by covering ground with 2-mil film overlapped 3- to 6-in.; this protects floor above against damage from dampness and rot. Sand or dirt on film keeps it in place. (Photos, Spencer Chemical Co.)

Moisture barrier of 4-mil polyethylene has been laid over gravel base before pouring concrete floor. Movement of men and materials on film prior to pour has not damaged it. (Photo, Spencer Chemical Co.)



Concrete poured without (left) and with (right) polyethylene form liner. The concrete poured with liner is smoother and stronger because of better cure. However, if film is not handled carefully in form, undesirable wrinkle lines result. (Photo, Spencer)

Promising market for polyethylene film is as moisture barrier material in side walls of homes and buildings. Film is easily applied and effective in protecting interior walls against damage resulting from condensation. (Photo, Visking Corp.)

construction uses ranges in thickness from 1 to 6 mils and in widths of from 3 to 32 feet. The primary reason for the importance of polyethylene film in construction is that it is moistureproof; other important factors which have been found advantageous are its ease of handling, strength, tear resistance, and durability.

Where it can go

End-uses include: 1) moisture barriers in home basements, crawl spaces, slabs, floors, walls, and ceilings; 2) in concrete work as form linings and for curing; 3) as protective coverings for machinery, materials, and buildings under construction.

An excellent basis for arriving at a theoretical potential market for film as a moisture barrier under concrete slabs is found in government statistics. Taking an average of 1170 sq. ft. per new home and assuming the use of 2- to 4-mil film, from 15 to 25 lb. of polyethylene film (considering overlap and waste) could be used per home. With a conservative estimate of 1 million new starts per year, and applying a government estimate of about 16% slab construction, 3 to 4 million lb./year could be consumed. Adding 1 or 2 million lb. for commercial and farm buildings gives a total theoretical potential of at least 4 million lb./year under concrete slabs alone. Geographically, the film potential in slab construction looks something like this: Northeast, 150,000 lb./year; North-central, 750,000 lb./year; South, 2,300,000 lb./year; West, 1,800,000 lb./year. These estimates reflect the fact that types of construction show considerable variation in different sections of the country.

Two closely related applications—covering

Three-story building under construction is completely enclosed by polyethylene film which permits work to proceed regardless of weather or season. Film admits daylight, bars rain and snow, keeps workers reasonably warm in winter. (Photo, Spencer Chemical Co.)

crawl spaces and placing under basement floors —offer excellent market potentials. Many homes have been or are being built with crawl spaces instead of basements, and these dwellings offer a special problem in moisture vapor control if the earth in the crawl space is not covered. If sufficient ventilation is provided to prevent vapor damage, the house will be cold. Without proper ventilation, the house will be damp and subject to dry rot.

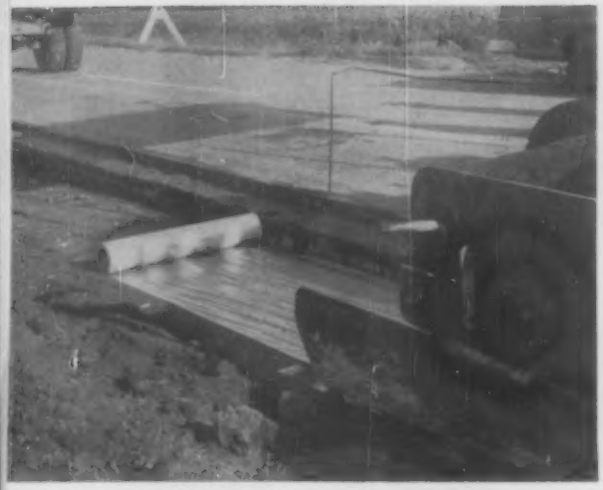
To provide almost 100% vapor control, the soil under the house can be covered with 2-mil polyethylene film, 3 to 6 ft. wide, lapping the edges 3 to 6 inches. In comparison with 55-lb. roofing paper, formerly recommended for crawl spaces, polyethylene weighs about $\frac{1}{50}$ as much and costs only one fourth as much. Only a small fraction of the crawl-space homes in the country are properly protected, which certainly suggests a latent potential "do-it-yourself" market.

Government figures indicate that about 40% of new homes are built with basements, and another 40% have crawl space construction. If an average of about one million new homes were built each year, the theoretical market potential for polyethylene film in basements and crawl spaces would be about 10 million lb., assuming 1170 sq. ft. per average home =12 lb. of 2 mil film. Adding a few million pounds for industrial and farm construction could bring the total film consumption to somewhere around 15 million lb. per year.

Materials and supplies are economically and efficiently protected from elements by polyethylene film. Unlike previously used canvas tarpaulins, film permits easy identification of covered material. (Photo, Visking)

In foundation walls

Polyethylene has a multi-purpose application in the erection of foundation walls. The film may be used to line the forms of poured foundations, thus providing a smoother finish



Three-foot widths of polyethylene film are used as a sub-grade moisture barrier in widening concrete highway. Film is rolled out in front of machine pouring the concrete. (Photos, Shellmar-Betner Div.)

Freshly poured addition to concrete highway is covered with polyethylene film curing aid. Dirt anchors film in place. Similar technique can be used in construction of new concrete highways. (See below)

as well as a moisture vapor barrier to facilitate curing. The film may also be placed outside the foundation wall prior to back-filling as an efficient moisture barrier for the finished foundation. The tough, resilient nature of polyethylene enables the contractor to minimize the possibility of tears when working in this way.

In home construction, polyethylene film is suitable for use as a moisture, dust, and dirt barrier in side walls, ceilings, and floors. It has been estimated that the average home could be completely enclosed with polyethylene for about $100. Moisture in side walls of houses causes dry rot in framing members, and paint failures inside and out. Polyethylene film 2 mils thick, applied with a stapling gun or tacks to studding, will protect against moisture. The film can be carefully sealed around pipes, fixtures, windows, and other irregularities, possibly with pressure-sensitive plastic tape. Using conservative estimates on new home construction, and assuming each home was "wrapped" in polyethylene, around 1,120,000,000 sq. ft. of 2-mil film could be used. This would mean about 10.8 million lbs. of polyethylene. Actual practice, however, indicates that moisture and dust barriers are not common in other than "quality-type" home construction.

Concrete of new highway is cured with polyethylene film. This application represents a big potential market. (Photo, Visking)

Highway uses

With the Government looking forward to a $100 billion highway construction program in the next 13 years, the use of polyethylene in the building of concrete highways is of more than passing interest. The State of Iowa, for example, in the 1956 State Highway Commission's specification book, spelled out the following requirements:

"4145.02 PLASTIC FILM. Plastic film used for curing of concrete shall be tough, pliable, moisture proof and sufficiently (*To page* 234)

Vinyl fishing lures

can be molded at home in simple aluminum molds from vari-colored plastisols

Plastisol molding moves into the kitchen with the introduction of the "Make-Ur-Bait" kit.[1] The kit consists of a 3-cavity, open aluminum mold, enough vinyl plastisol[2] in four colors to make up 200 baits, fish hooks, a filling rod, and, of course, instructions. The purchaser furnishes the equivalent of a hot plate and quench tank — the hot plate may be an electric skillet, a stove element, a metal plate on a gas flame, or what have you. Additional molds and a wide range of colors are available to the more eager and imaginative home lure makers.

The process is simple. The cast aluminum mold, clean, dry, and cold, is laid on the table, cavity upwards, and the appropriate color plastisol is dripped into the mold with the aluminum filling rod. The mold is thus filled until the liquid level is up to the plane of the mold face. Feelers, legs, and toes of insects, crayfish, and frogs are filled by drawing the vinyl suspension into them with the tapered point of the rod (Fig. 1). Any slopover is easily wiped away with a cotton swab. The filled mold is set on the hot plate, ideally reaching 375° F. However, no thermometer is needed because the plastisol changes color slightly and becomes opaque when fusion is complete, as in Fig. 2. The thick center section is last to fuse, and, as it begins to change in color the hook is set into place. At this stage the resin is viscous enough to keep the hook from tilting out of the vertical. While mold temperature is not absolutely critical, the resin will char if it gets too hot.

The mold and fused molding are lifted with a pancake turner and slid into a tray of cool water (Fig. 3) where the vinyl resin chills into its firm, flexible, finished form, and at the same time shrinks more than does the mold. This makes it easy to strip out of the mold (Fig. 4) without the aid of any special mold release agent. Working at a leisurely pace, a novice will have his first lure in ten minutes.

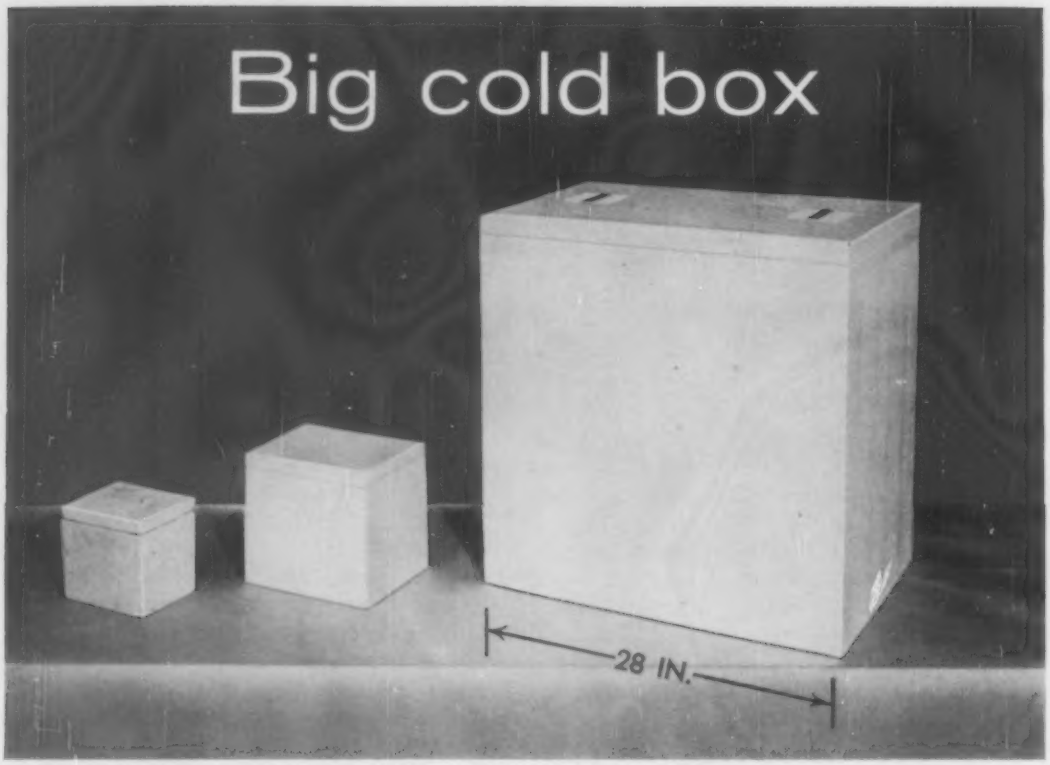
[1]Kit is a product of Lois Richards, Inc., Cleveland, Ohio.
[2]Plastisols by Kee-Bair Products (Cleveland) from B. F. Goodrich Chemical Co.'s Geon 121.

Fig. 1: Filling crayfish's legs. Spots on frog were made by first dotting cavity with brown, then filling with green

Fig. 2 (right): Excess resin is swabbed while lure cures on sandwich toaster. Note darkening of fused parts

Fig. 3 (below): Cured crayfish takes to the water for a quick quench.
Fig. 4 (right): Tail fins are loosened to start stripping. Even the fine antennae and crooked legs of the roach (center, Fig. 2) strip cleanly

Big cold box



Expanded styrene containers are molded in three sizes. Dimensions of two boxes at left are such that the smaller unit fits into the larger one to provide a cavity with double the wall thickness of either box

Low-temperature storage box inside deep-freeze unit holds about 1500 vials of bull semen and 200 lb. of dry ice. Consumption of dry ice is about 4 lb. per day, eliminating need for frequent re-icing

The rapidly expanding use of artificial insemination in cattle breeding has depended largely upon efficient refrigeration. Unless the valuable bull sperm used in this work is held at very low temperatures during storage and shipment, its usefulness is quickly lost.

Seeking improved methods of refrigerating the bull semen shipped to its members, the Northern Ohio Breeders' Cooperative Association, Tiffin, Ohio, has enlisted the superior thermal insulating characteristics of foamed styrene. Initially, slabs of styrene foam were fabricated into box-like containers in which the vials of semen could be kept under low-temperature refrigeration. More recently, the plastics containers have been molded, using expandable styrene beads in a mold equipped with multiple steam probes. According to Max Drake, association manager, nothing has been found to date to compare with the molded expanded styrene boxes for the purpose. It was noted, for example, that the excellent thermal insulating characteristics of the molded expandable styrene material, plus the elimination of seams,

Molded of expandable styrene beads, new container provides more efficient refrigeration for shipping and storing specialty products

made it possible to obtain the same insulating efficiency with walls only about half as thick as those used in the fabricated foamed styrene containers.

The new molded expanded styrene containers are made in three basic sizes. Largest of these units is a container measuring 28 by 28 by 19 in., with a wall section of approximately 3 in. and a weight of 12 pounds. Others include a medium sized unit—7¼ by 5½ by 7¼ in., weighing 1 lb.; the smallest container is 7¾ by 6¾ by 5¾ in. with lid in place.

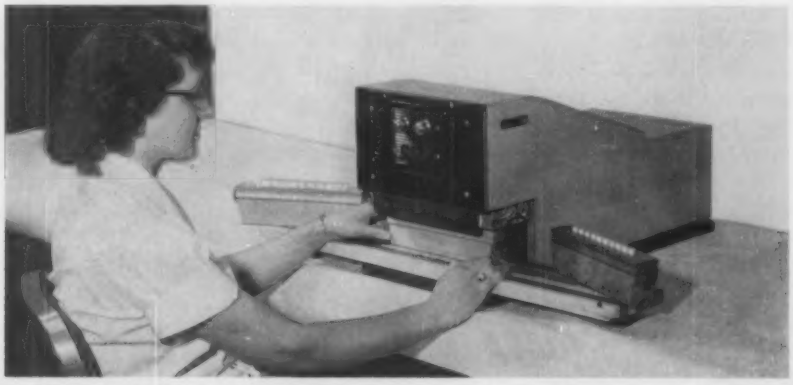
Although the large container, with its tight-fitting lift-off cover molded of the same type material, can be placed in a wooden shipping container and used for shipping vials of dry-ice-refrigerated bull semen long distances, its primary function is as an insulating inner compartment in low-temperature storage cabinets.

By placing the molded plastic units in a low-temperature storage cabinet, it is possible to maintain temperatures of dry ice (—110° F.) for long periods. One such unit will store approximately 1500 vials of semen along with 200 lb. of dry ice. Because of the insulating properties of the molded expanded styrene, this unit uses only about 4 lb. of dry ice daily. Development work has also been done on molding cooling coils directly into the plastic container so that no outer box is required.

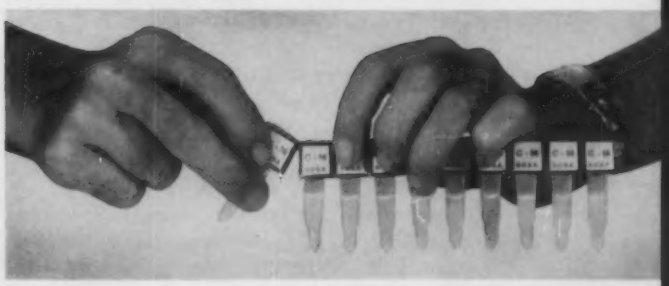
Polyethylene vials used

One method used in storing the polyethylene vials of semen is to place a protective sheet metal liner inside the plastic container. Metal trays used with the liner hold the sealed vials in a vertical position so that the coded information can be read conveniently. The filled polyethylene vials of bull semen are sealed and labeled in strips of ten, using a machine specially developed for this purpose.

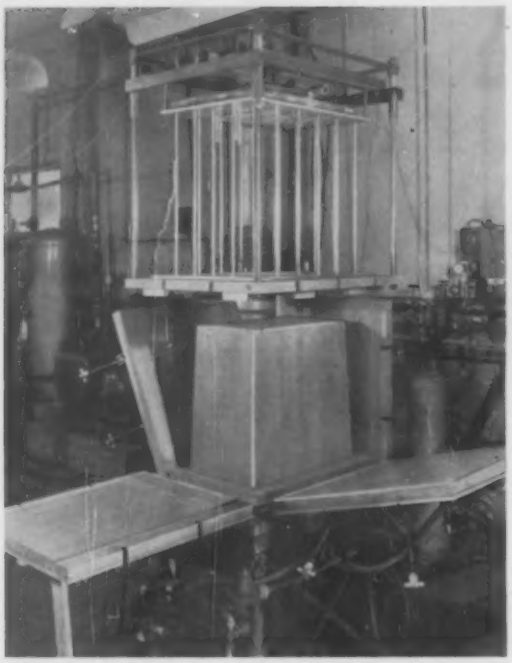
The large insulating container, exclusive of



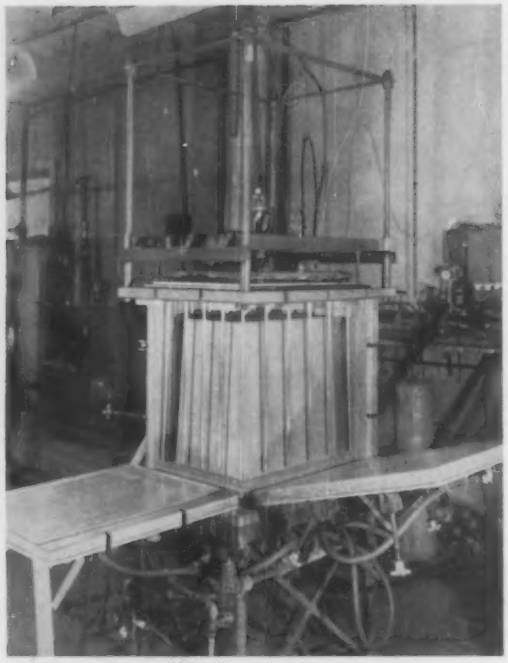
Polyethylene vials containing bull semen are sealed and labeled in strips of ten. Machine will label 10 vials every 15 sec., or about 2400 per hour. (Photos, Northern Ohio Breeders' Co-op. Assn.)



Individual vials are easily removed from strip of 10 . . . a twisting motion snaps label from strip and releases vial. These containers can be used for storing a variety of living cellular organisms, including semen



Cold box mold in open position. Hinged side-walls can be laid back to permit easy removal of molded part. Steam probes are suspended over mold



Steam probes in molding position. Steam circulating through probes expands styrene beads. (Sides, which are up during molding, are shown here lowered to reveal detail)

the removable cover, is molded in one piece. As received by the molder, the beads have a density of between 30 and 40 lb./cu. ft. Prior to the actual molding operation, they are pre-expanded by being passed beneath a battery of heat lamps mounted above a revolving turntable. Feeding by gravity from a hopper equipped with a vibrating device, the beads pass out through a slot which distributes them in a uniform layer on the turntable.

In molding this type of material, the preferred method of supplying heat to expand the styrene beads is by means of dry steam. The large container is molded with the open side downward to facilitate the molding operation and simplify removal of the part from the die. The container is molded with no draft on the outer walls; inner walls, having a slight taper, are formed by a large plug which is an integral part of the bottom of the mold.

Hinged side-walls in mold

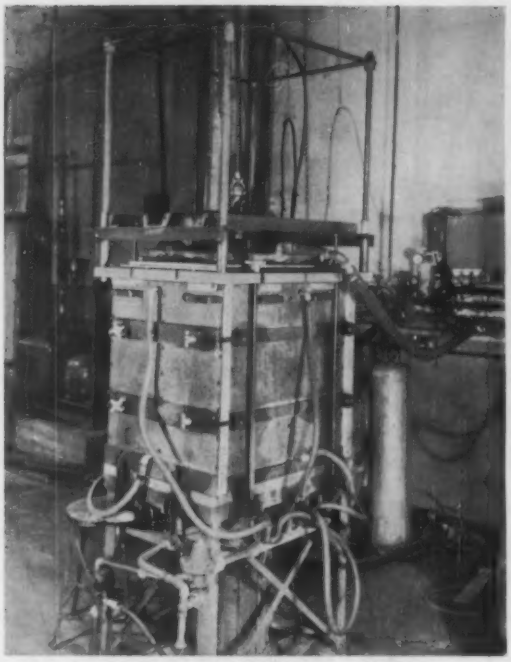
To overcome the special problems involved in producing a piece of this size and shape, the molder designed the mold cavity with side-walls hinged at the bottom. This permits the walls to be swung back so that the piece can be readily lifted off the punch. The aluminum die, which weighs approximately 1500 lb., is of rugged construction to withstand the pressure of the expanding plastic material and avoid bowed sides in the finished container. Side-walls of the die are cored for water circulation to expedite cooling of the part before removal from the mold. The aluminum plug or core is also equipped with an internal spray arrangement so that cold water can be circulated through it.

Perforated probes introduce steam

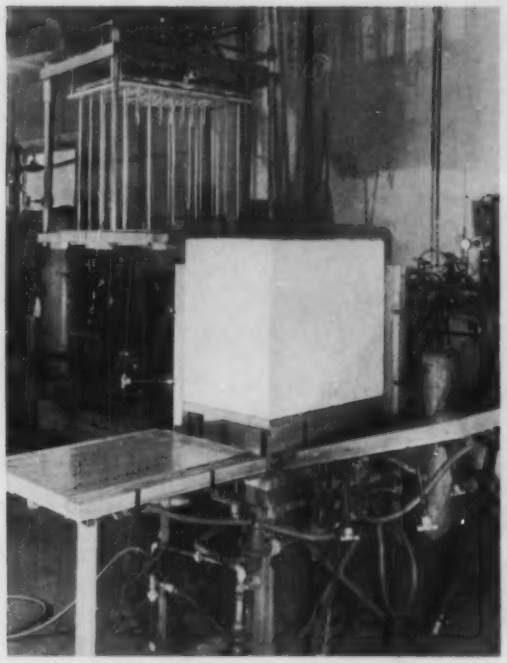
Steam for expanding the styrene beads is introduced by a group of perforated stainless steel probes. These probes are brazed to a header arrangement mounted so that they can be lowered into position for molding or shifted away from the top of the mold when the part is ready to be removed.

In molding one of the large containers, the procedure is as follows:

First, the hinged sides of the cavity are



Mold in closed position. Sidewalls are held in place by metal straps and clamps. Cover plate is secured by vertical tie rods. Boiler in left background supplies steam



Molded container at end of cycle. Steam probes and header have been lifted up and moved to one side to facilitate removal of box. (Photos, The Fabri-Form Co.)

raised to upright position and secured by means of the metal straps and corner bolts. The pre-expanded styrene beads are then dumped into the open top of the die until the wall and bottom areas are filled. Following the introduction of the beads, the metal plate which forms the bottom surface of the box is lowered in place and secured in position by vertical tie rods.

The header arrangement with its array of steam probes is then lowered into position, the probes passing into the open wall areas through matching openings in the die cover plate. Cooling water remaining in the tubes of the mold walls is then forced out by air to prevent buildup of internal pressure when the mold is heated.

With the probes in the lowered position, steam is then introduced into the mold for approximately 1 min., causing the styrene beads to fill out the sidewalls and bottom of the container. Probes are then withdrawn and cooling water is circulated through the sidewalls and core of the mold for about 10 minutes. Substantially the same procedure is used in molding the lid of the container, designed with an offset edge which fits down snugly within the outer unit.

Styrene breaker frame

To protect the edge of the container walls at the point where the top is inserted, a durable breaker frame, vacuum formed from high-impact styrene sheet stock, is cemented in place. (The stock from which this piece is made is produced by the fabricator on his own extrusion equipment.) Only other fabricating operation is the mounting of the metal cover handles.

These large expanded styrene units mark an interesting new approach in the use of expandable plastics in the refrigeration field. The successful experience of the Northern Ohio Breeders' Cooperative Association should also suggest numerous other ways in which this material could be put to work where there is a need for molded components, large or small, having unusual insulating efficiency.

Credits: Containers molded by The Fabri-Form Co., Byesville, Ohio, using Koppers expandable styrene beads.

Seedling is planted through slit made in black polyethylene film. Printed grid lines permit accurate spacing, give professional look to amateur horticulturists' efforts

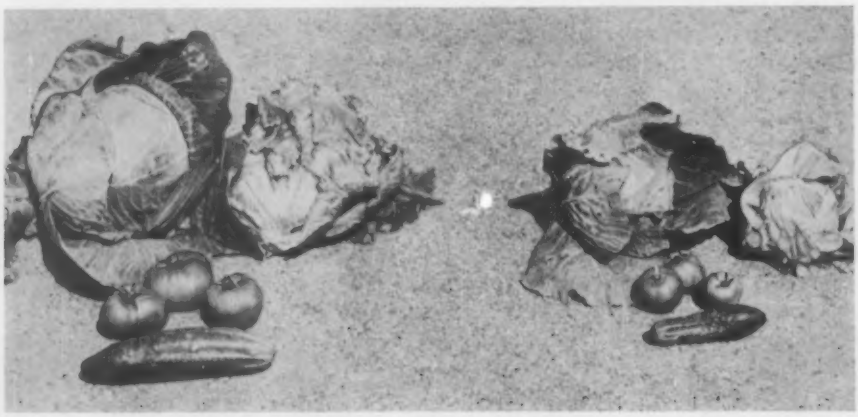
PRINTED MULCH

For the backyard gardener, black polyethylene film now comes with an imprinted grid for proper spacing of seedlings in a weedless garden

The use of polyethylene film by big-scale horticulturists is becoming an accepted practice (MODERN PLASTICS, *34*, 112, Sept. 1956), but until recently the purposes and methods of this practice were unknown to the small private gardener and proper materials for his use were unavailable.

Now, as a result of cooperation between a resin maker, a film extruder, a film printing house, and a university, the backyard gardener is offered a specialized black 1½-mil polyethylene film, 27 in. wide, printed in a grass-green

At University of Kentucky's Agricultural Experiment Station, vegetables grown with polyethylene mulch (left) were much larger than those grown in unmulched soil (right). (Photo, Bakelite Co.)



In weedless-garden experiment at University of Kentucky, polyethylene mulch film left on ground during winter kept soil uncompacted and moist

grid with markings in 1-in. square units to enable him to plant seeds, seedlings, plants, and bushes at proper distances in a weed-free and moisture-saving garden.

Experiments conducted under the direction of Dr. E. M. Emmert at the University of Kentucky Agricultural Experimental Station were designed to test films for mulch functions — prevention of evaporation of soil moisture, increasing soil temperature, curtailing weed growth, and preventing produce from rotting on moist ground.

The experiments proved that black polyethylene film performed all those functions better and more cheaply than any other mulch ever tried. Mulched vegetable and flower seeds germinate and grow faster than unmulched ones. Soil temperatures under the mulch in spring were up to 10° higher than those of bare ground. With the light cut off, weeds underneath the mulch died. Standard procedure is to fertilize and till the soil and wet it, then to place the black polyethylene film over the bed, pinning down the edges with rocks, soil, or sticks. Where a seedling is to be planted, an "X" cut is made with a razor blade or pocket knife and the planting done through the cross-slit. Large seed vegetables are planted using a sharp pointed instrument that will pierce the film but not tear it. The film closes back to a narrow slit through which the plant will emerge. Small seeds — both vegetable and flower — are best planted through a hole about 1 in. in diameter cut in the film.

A further finding of the University of Kentucky horticulturists is that mulch film left in place over winter keeps the soil soft and moist (as if it had been freshly cultivated) and vegetables planted through the year-old slits appear to thrive as well or better the second year than they did the first.

Hothouse tomatoes and peppers are planted with a trowel through slits in polyethylene film. (Photos, Bakelite Co.)

Cov-R-Gro Corp., Trenton, N.J., is offering the new grid-printed polyethylene mulch to home gardeners under the trade name "Cov-R-Gro."

Credits: Specially formulated black polyethylene by Bakelite Co., Div. Union Carbide and Carbon Corp; film extruded by Visking Corp.

At the 1957 National SPI Conference

In Los Angeles, Calif., from March 18 through March 21, for the first time in history a National Conference of The Society of the Plastics Industry was held on the Pacific Coast, at the Biltmore Hotel. Simultaneously was staged the first official Pacific Coast Plastics Exposition at the Shrine Auditorium.

Attendance at both Conference and Exposition was good and enthusiasm concerning the future of plastics in the Far West ran high.

Opening business session

Under the chairmanship of James Prior, Sierra Electric Corp., past chairman of Pacific Coast Section S.P.I., that section held its annual business meeting, electing the following officers for the coming year: chairman, Elmer N. Huling, Wilcox Plastics, Inc.; vice chairman, John L. Stief, Jr., Coast Mfg. & Supply Co.; secretary, John Delmonte, Furane Plastics, Inc.; treasurer, Lynn Roberts, Leedy Products, Inc.

Following this session the Annual National S.P.I. Business Meeting was held, the chairman being Norman Anderson, General Molded Products, Inc., National President of S.P.I. In his address Mr. Anderson congratulated J. Allen Carmien, New Plastic Corp., and General Chairman of the Conference, on developing an excellent program. He pointed out that through population growth and industrial development the share of industry volume enjoyed by the western states is increasing, but stressed the importance of management policies at processor level because of the profit squeeze.

The S.P.I. Financial Report for 1956 was presented by William Bird, Prolon Plastics, who is treasurer; a review of divisional, sectional, and committee activities, with particular reference to standards, was presented by William T. Cruse, Executive Vice President.

Keynote address was by Robert Prescott, President, Flying Tiger Lines, who emphasized the importance of plastics to the air transportation industry.

Plastics in aircraft and defense

On Tuesday, March 19, the above subject was exhaustively treated under the co-chairmanship of Samuel S. Oleesky, Zenith Plastics Corp., and B. Goldsworthy, consultant.

"Reinforced Plastics for Rocket Applications" was discussed by George Epstein, Aerojet-General Corp. Approximately half this paper was devoted to Aerojet's work in pressure vessels using filament-wound structures. (See MODERN PLASTICS, *34*, 132, March, 1957.) But the balance provided a fascinating glimpse of a segment of industry where plastics are not viewed as something that should be strong, durable, and of permanent value, but as expendable material which, like the propellent in a rocket, serves its user when it is destroyed.

The talk was studded with comments that various silicone and modified phenolic and polyester resins were "satisfactory" at temperatures of 3000 to 5000° F. This meant that they disintegrated at a slow enough rate so that there is something structurally left at the end of a 2- to 5-sec. firing blast. Here, the major attribute of plastics is its high insulating quality.

Plastics in this application must also display a high resistance to "gas erosion." Not only are temperatures high, but they generally come from blasts of hot gas that sweep over the plastic surfaces at tremendous speeds.

Plastics are not as serviceable as metals in either temperature resistance or gas-erosion resistance, as a function of structural strength. But, on a weight basis, they can be valuable adjuncts to metal structures as liners, coverings, etc., allowing the engineer to design for much lower metal temperatures. The net results are very large savings in weight.

"Self-expanding Polystyrene Foam—A New Low-Density Molding Material" was presented by J. A. Struthers, Jr., The Dow Chemical Co. The technique of making this most unusual material is to combine exothermic thermosetting resins with expandable thermoplastic resins so that the thermosetting resin produces heat during its cure, which heat is used to foam the thermoplastic. Since the foaming material fills the center of the structure and pushes the hard thermosetting material to the outside, the result

and First Pacific Coast Exposition

is a "sandwich" with a stiff, structural skin of thermosetting resin completely surrounding a light, thermoplastic-foam center. If the thermosetting resin is one that displays good bonding characteristics, the foaming mixture lends itself to foam-in-place applications such as in aircraft structures, insulating panels, building panels, and similar end-products.

The Dow talk was based on a mixture, identified as Q-24124, of epoxy resin and expandable polystyrene. This mixture produces structures with a very hard dense skin. The skin has a high resistance to heat deformation, but a low insulating factor. The core has the reverse of this—little resistance to heat, but a high insulating factor.

Dow's final note was that this material is so different from either of its "parents," that it is difficult to evaluate it in terms of present fabricating techniques. Its true worth will not be realized until plastics engineers view it as a completely new type of plastic, a plastic that requires its own fabrication techniques, design parameters, etc.

"Fibrous Glass for Missile Usage" was the subject of a paper given by T. E. Holdridge, Hughes Aircraft Weapon Systems Development Labs. The work at Hughes is related to production problems on the Falcon, an air-to-air missile built largely of plastics. Many of the laminates used are only 0.040 in. thick; consequently, quality control covering every phase of the fabrication is necessary.

Hughes engineers decided that not enough attention had been given to the glass cloth used in these laminates. Designers generally assume that they can count on the full strength of the glass in the direction of the warp and fill threads. Preliminary investigation, using microscope and X-rays, showed that movement of the resin and contouring of the part generally, and unpredictably, pulled the threads out of shape.

The first problem was to develop a testing or inspection technique that could be used on a production line basis. Working with United Merchants Industrial Fabrics, Hughes finally arrived at a special weave ideal for this purpose. Every sixteenth fill thread is left out. Using this special glass cloth, Hughes engineers could trace the movement of the threads as the cloth progresses through the fabrication procedure, from cutting, to impregnation, to lay-up, to cure, etc.

A large part of the talk was devoted to the use of this new cloth as an experimental medium for changing thread and filament counts. It was finally decided that the use of much finer filaments in the fill position would result in cloth with a lower distortion factor. The cloth also results in structures with a higher glass-to-resin ratio. These new cloths are now commercially available through United Merchants Industrial Fabrics.

"New Epoxy Resins for Reinforced Plastics" were discussed by P. A. Thomas, Bakelite Co. A new epoxy material (EP-201) described in this paper is still in the development stage, and the talk was centered primarily on a wide range of application experiments, using various curing agents. Methods of handling the resin and laminate fabrication techniques were described by the author.

"Filament-Wound Structures" was the title of a paper given by Robert Noland, Reinhold Engineering and Plastics Co. Mr. Noland spoke entirely without notes or slides, commenting generally on the work of his company with filament-wound structures. One problem with some filament-wound vessels is that they are too strong in the direction of the winding. They do not give under pressure to equalize the pressure loads. He cited a closed-end pressure cylinder, in which the point of greatest weakness is the edge around the two ends. A metal pressure cylinder will balloon slightly at this point and provide a rounded edge for maximum strength. A filament-wound structure will simply burst.

One solution is to line the pressure vessel with a soft material, such as vinyl, which will tend to flow and thus equalize pressures.

He also described structures made of metal

encased in a filament-wound covering. Under pressure, the metal expands, work-hardening as it goes, until the plastic takes over.

Plastics in consumer goods

Under the co-chairmanship of L. H. Glaser, Revell Inc., and J. N. Jayne, The Plas-Tex Corp., plastics housewares and toys were discussed, particularly from the standpoint of consumer goods merchandising.

"Special Applications of the New Polyolefins" was the subject of a paper by V. Hill and D. Jones, Celanese Corp. of America. The exceptional heat resistance and increased rigidity of of the new resin enables molders to overcome shortcomings in former polyethylene types as well as in certain styrene resins. It was shown that lighter-weight pieces with thinner walls could be produced with distinct economy. Formed rigid sheet polyolefin offers new opportunities in large toys and in housewares.

"Design Trends in Plastics Housewares" were discussed by James Kelson, Packard-Bell Co. Mr. Kelson stressed that design is the biggest single factor in profitable merchandising of plastics housewares through the use of new forms, textures, and colors.

"Hobby Merchandise" was the subject of an address by L. H. Glaser, Revell, Inc., who stressed the importance of discount and shipping policies, of informative labeling and packaging, of point of sale factors to cut sales resistance, of national advertising backed by distributors, and of a continuing public relations program. He declared that consumer research at trade level is much less expensive than most proprietary producers believe.

"Merchandising and Growth Problems of the Industry as a Whole" were analyzed by J. A. Jayne, The Plas-Tex Corp. Pointing out that plastics today account for 10% of the whole housewares industry and has grown to a 200-billion dollar business in ten years, Mr. Jayne expressed the opinion that the industry faces the greatest potential in history. He stressed that three basic values are necessary in any housewares item: a) value of a useful possession, b) value as profitable merchandise, and c) value as a manufactured product.

Mr. Jayne advised material makers to be more careful of making material price changes, particularly as concerns timing of announcements. He suggested that they disseminate more rapidly information on technical changes in materials, and urged the cooperation of the industry as a whole in establishing policies on material warranties and on credit.

"The Function of Raw Material Suppliers in Helping Expand Markets of Plastic Consumer Goods Manufacturers" was a panel which included the above speakers as well as Clint Blount, vice pres. in charge of marketing, Bakelite Co.; Corliss Cummins, manager, Plastics Dept., The Dow Chemical Co.; Theodore Lauden, asst. dir. of sales, Plastics Div., Monsanto Chemical Co.; and Sidney Ullman, pres., Royal Plastics Products. A pointed suggestion that material makers engage in cooperative advertising with housewares molders was rebutted on the basis of legality and practicality by the material makers represented on the panel.

A concurrent session of the S.P.I. National Molders' Management Division was held on Tuesday with R. B. Gutsch of aaRBee Plastic Co. presiding, and Ned H. Porte, General American Transportation Corp., discussing "Pitfalls in the Preparation of a Quotation." In general, this material was similar to that presented in MODERN PLASTICS Magazine, July 1956, page 81.

Aircraft needs in plastics

Luncheon speaker on Tuesday was Brig. General Thomas Bryan, Wright Air Development Center. The General pointed out that the next war will be decided in a few days and entirely by air. Meanwhile, the cold war is being fought in time and technology so that the nation which packs the greatest technological advances into the shortest space of time will stand the best chance of winning a hot war. Needed are plastics materials with much greater heat resistance and higher modulus of elasticity. Transparent materials are theoretically possible that will stand 1000° F. for extended periods of time, and reinforced plastics that can take the heat generated at three and four times the speed of sound should be a goal.

Plastics in electrics and electronics

George Firt, Applied Plastics Co., presided over a session of specialized interest to the above industries.

"Evaluation Tests for Epoxy Casting Systems" were discussed by M. V. Goodyear, Houghton Laboratories. Missile engineers view plastics as

expendable materials; for this reason, ordinary specifications sheets are not of great value to them. Such specifications generally show the limits to which the plastic can go. Missile engineers are more interested in knowing what happens to the plastics, and at what rate, beyond these limits.

Mr. Goodyear's paper described a series of tests designed to produce such data. Epoxies used for electronic insulation purposes were subjected to temperatures far in excess of their normal limits. Not surprisingly, it appears that different plastics show widely differing reactions to this sort of treatment.

Certain basic rules of thumb can be derived from the tests:

1) Failure always comes in the form of physical collapse. There is never a drop in electrical properties before the piece disintegrates. Physical failure comes in the form of cracks, blisters, etc. The best way to protect the electrical qualities of a piece, therefore, is to keep it integral as long as possible.

2) Non-active additives, plasticizers, etc., are lost immediately, boiling out of the material at the high heat. They should, therefore, be left out of any formulation that is to be subjected to high temperatures.

3) Cracks and shrinkage come coincidentally with weight loss. High temperatures generally have no effect on filler material, consequently the highest possible percentage of filler will keep the net weight loss at a minimum.

"Epoxy Casting Resins for Electrical Applications" was the subject of a paper by W. E. Weber, Hughes Aircraft Co. Epoxy resin systems have so many variables—resins, hardener, cure-rate, etc.—that it takes extensive testing to select the best combination. This paper described a large series of such tests, outlining the various techniques used and presenting many of the results.

"Military Standards for Plastics in Electrical and Electronic Applications," by John B. Alfers, Dept. of the Navy. The speaker emphasized that, with the large variety of plastics now available, it is imperative that buying agencies within the government, and fabricators working on government contracts, have some kind of guideposts to go by. The result is a very complete set of military specifications on plastic materials and fabricating techniques.

The specifications and standards were divided into two major groups. One of these include the government specifications that are identical with commercial specifications; the second category covers those that differ materially from commercial specifications. These differences are based on differing requirements met in government service. Plastics for use on shipboard, for example, must have flame resistance characteristics beyond those of plastics used in everyday commercial work.

"Linear Polyethylene and Chlorinated Polyether—Two New Raw Materials for the Electrical Insulating Industry," by E. W. Cronin, Hercules Powder Co. Data were presented to show that linear polyethylene has more heat, abrasion, and arc resistance; better stress crazing properties; and more dimensional strength and hardness than the conventional branched type. It was news to some in the audience that there has been some problem in applying the new polyethylene to certain electrical applications because of a carry-over of catalytic impurity such as aluminum and titanium ash.

The new chlorinated polyether discussed is characterized by superior dimensional stability under adverse conditions of heat and moisture. The material sets by crystallization rather than by cooling, which means less shrinkage in the mold, and the chlorine content was declared to be firmly locked into the molecule, permitting molding temperatures up to 500° F. without release of chlorine.

Plastics in chemical process

E. Bushman, General American Transportation Corp., presided over this session.

First paper was a discussion of **"Plastics in the Marine Fields"** by John Marzicola, Zenith Plastics Co. Essentially the same material was offered in an article by Mr. Marzicola beginning on page 146 in the March 1957 issue of MODERN PLASTICS Magazine.

"Plastics in the Agricultural Industry" was the subject of H. E. Pinches, U. S. Dept. of Agriculture, and Dr. C. E. Staff, Bakelite Co. The possible increased use of plastics in water management, irrigation, land drainage, erosion control, in crop production, control of pests, farm structures, machinery storage, produce storage, and marketing were all discussed.

"Plastics Swimming Pool Construction" was treated by Dr. C. Richman, Paradise Pools, Inc. in an early issue of MODERN PLASTICS Magazine. The whole subject of plastic (*To page* 238)

Pump for inflatables

A new vinyl plastic pump makes a simple task of the inflation of air mattresses, wading pools, and other inflatables. Called the Dapco Inflato-bag, it is supplied only with each item of the line of inflatables produced by its maker.

The pump, which has no mechanical parts, is simply a flexible vinyl bag with a special valve at the bottom. From this valve a length of tubing connects to the inflatable. In use, the top of the bag is folded together, forming a large air pocket. As the user leans over, with the bag top firmly gripped in his hands, his body weight presses down on the air pocket and the entrapped air is forced out through the valve and into the inflatable. When not in use, the bag folds compactly to pocket size and is almost as easy to carry as a handkerchief.

Credits: Dapco Inflato-bag fabricated by Davis Products, Inc., Santa Monica, Calif., using Boltaflex vinyl manufactured by The General Tire and Rubber Co.'s Pennsylvania Div.

PLASTICS

Compression molded

Now being widely promoted to retail outlets and consumers in Australia, attractively designed occasional tables are completely compression molded in five parts—top and four legs. The material used is either phenolic or urea, depending upon the color desired. Molded phenolic tables are produced in mahogany and walnut colors; urea units are available in ivory, pink, and green.

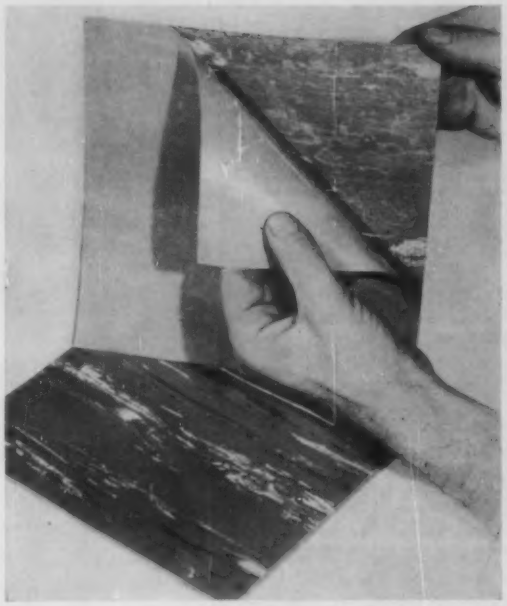
Produced in a medium size—19½ in. long by 13½ in. wide by 18 in. high—the tables are suitable for night-table use in the bedroom, as play tables for children, for the telephone, etc. Advertising of these tables stresses sturdy construction coupled with light weight, imperviousness to heat and hot liquids, scratch resistance, and color that goes all the way through the molded parts.

Of particular interest is the method of fastening the separately molded legs to the table top. Molded into the four corners of the under side of the top are triangular recesses; the upper end of each leg

Floor tile that sticks

A built-in pressure sensitive adhesive backing makes a new vinyl floor tile easy to apply over any smooth surface. Called Peel 'N Stick, the new flooring is supplied to the user with the adhesive coating protected by a thin sheet of polyethylene-treated paper which overhangs on all four sides. Professionals or do-it-yourself decorators can simply peel off the paper and stick the tiles in place without the use of solvents or additional adhesive. The tile requires no rolling after installation nor is a "drying-out" period necessary before furniture can be moved back into the room. Because the factory-applied adhesive is dry, there is no problem of adhesive flowing up through the joints and pressure can be applied against each adjoining tile as it is laid. This reduces the width of the seams and results in a smoother finished surface.

Credits: Floor tile produced by Robbins Floor Products, Inc., Tuscumbia, Ala., using vinyl resin supplied by Bakelite Co., New York, N.Y.

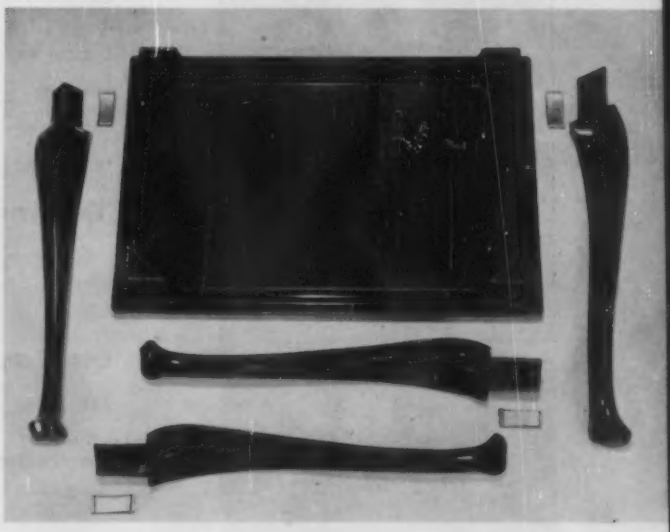


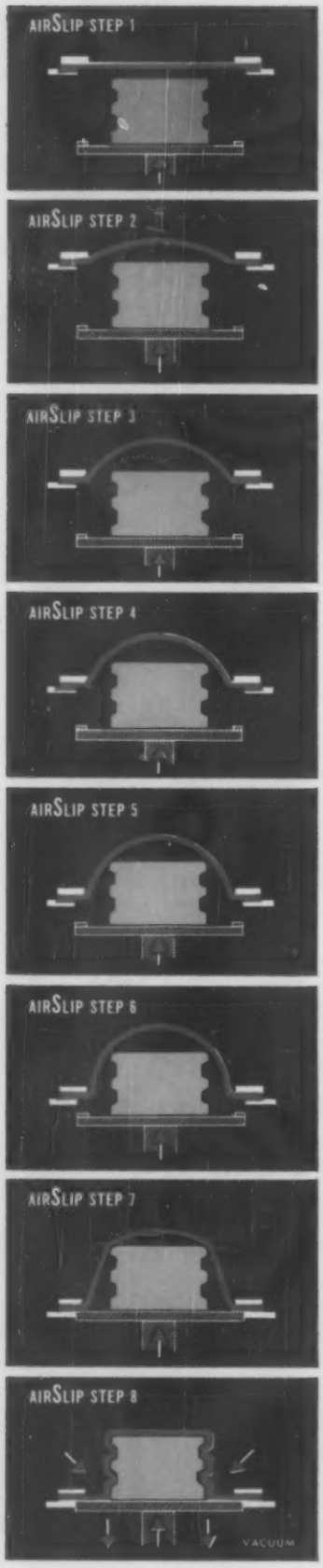
PRODUCTS

occasional tables have detachable legs

is of triangular shape which is an easy slip-fit for the molded-in recesses. Tolerances are such that the legs will fit regardless of any normal shrinkage that takes place after molding. Any looseness of the joints is taken up by four flat steel spring clips supplied with each table. When the table is to be put together, one of these clips is placed in position on the inner face of the triangular upper part of the leg. Then clip and leg top are simultaneously pressed into one of the triangular sockets in the top; when completely seated in the recess, the leg is held securely against wobbling or falling out when the table is lifted or moved. Advantages of this design include savings in packing and freight costs because the tables can be shipped with the legs detached, and more compact storage in the home because the legs can be as readily removed as they are inserted in position.

Credit: Byron occasional tables are molded by A.C.I. Plastics Pty., Ltd., Spotswood, Victoria, Australia





the AirSlip Story

BY WELDING ENGINEERS, Inc.

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Only with "AirSlip" can many difficult forming problems be solved successfully and economically.

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★ Patents Pending

Plastics Engineering

Dr. James F. Carley, Engineering Editor

Estimating for reinforced plastics

By Frank W. Shefflert

Competitive, profitable operation and satisfaction of the customer in the reinforced plastics fabricating business depend heavily on sound estimating procedure. A good estimate should define the product, provide reliable prices and delivery dates, and guide manufacturing personnel. Carefully developed estimating forms (samples are shown) improve the reliability of estimates and provide records. Labor estimates should be based on a definite, visualized plan of operations; they may be checked by formulas that abstract past experience in the basic operations.

In all reinforced-plactics work there is an initial "learning" period during which the amount of labor per unit produced decreases steadily to a final constant value. Most of what is learned is retained from order to re-order on the same job and can be passed on to other workers. Learning curves based on past performance records on similar jobs provide a valuable basis for estimating start-up labor loads; their use is demonstrated.

To be most effective, the members of the estimating group should have good engineering backgrounds and should report directly to top management.

Cost estimating in any reinforced plastics facility is a rather complex function. Cost estimates must be prepared in relatively short periods of time, and must cover an incredible range of variation with respect to physical and chemical requirements of products, materials of construction, quantities, types of tools employed, and fabricating operations. The problems of making order out of this apparent chaos are many and varied, but well worth the effort.

Fabrication of reinforced plastics embraces a wide variety of techniques. In addition to a multitude of molding processes, including contact (no pressure) hand layup molding, mandrel wrapping, vacuum bag molding, pressure bag molding, diffusion (marco) molding, compression molding, and transfer molding, many and varied postmolding processes are utilized, such as sawing, routing, blanking, shearing, drilling, punching, riveting, sanding, sandblasting, planing, milling, tapping, grinding, turning, bonding, priming, painting, and packaging.

A seemingly endless variety of materials of construction, many with unique processing techniques, are utilized. These include many kinds of resins from various families, covering a wide range of chemical and physical properties, reinforcements of both synthetic and natural origin in many different forms, various catalyst systems, a multitude of core materials, a wide variety of surfacing materials including overlay resins and reinforcements, and so on, almost *ad infinitum*.

To complicate matters further, products range in size from a tiny electrical part weighing an ounce or two to a 36-ft.-long LCVP weighing nine tons, and they range in shape from simple flats to exceedingly complex structures having many corners, joints, and compound curves.

Functions and makeup of estimate

In terms of its functions, an estimate should accomplish the following three aims:

1) It should completely define the product being estimated. In most cases, this is done to some extent by the customer through drawings and specifications. It is up to the estimator to supplement this customer-supplied product data with manufacturing tolerances (if not given), surface appearance (roughness, visual imperfections, color, etc.), recommended modifications to facilitate fabrication (draft allowance, minimum edge and corner radii, etc.), mechanical and chemical laminate properties, and recommended methods of assembly where indicated. In general, as

*Reg. U. S. Pat. Off.

† Lunn Laminates, Inc., Huntington Station, N. Y.

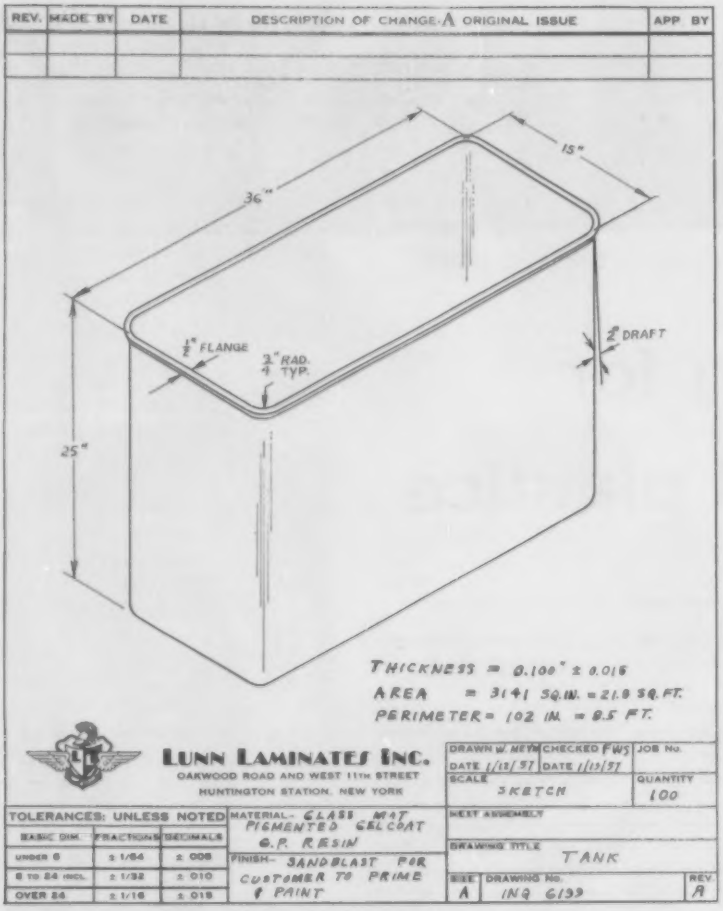


Fig. 1: Preliminary sketch of tank for which sample calculations are included in forms A1 to F

many variables as possible should be defined and limited. Often a sample laminate, typical of the expected product, can be provided to the customer. If this is done, "perfect" samples should be avoided to prevent future misunderstandings with customers regarding quality of production lots.

2) Provide the customer with reliable price and delivery information. Deliveries should be predicated on realistic tool delivery estimates and anticipated rates of production. Prices should include the prices to be charged for tooling and engineering services.

3) When the order is received, the manufacturing and job planning functions should receive the estimating data used to prepare the quotation in sufficient detail to permit the performance of the job in accordance with the estimate.

In terms of its component parts, an estimate can be defined as follows:

1) Information supplied to estimating: The product and/or services that are to be performed must be defined to the estimating function.

2) Basic data and computations: Certain calculations must be performed to convert the supplied information into more usable form for developing further cost data.

3) Bills of material: The raw materials and purchased services to manufacture the finished product must be estimated and priced out.

4) Labor bills: The labor needed to perform the various manufacturing operations on the product must be estimated.

5) Engineering and tooling bills: The cost of pre-production labor and materials, and the cost of manufacturing tools must be computed.

6) Scheduling: The time required to produce the first unit and subsequent rates of production must be calculated.

7) Summary: All the above data must be summarized and, where necessary, explained in further detail for presentation to the prospective customer.

Qualifying estimates

In addition to providing cost and delivery information, an estimate must also clarify those points which may lead to misunderstanding between fabricator and customer concerning the product. These fall into two classes:

1) Product characteristics not completely described or defined by the customer. Instances of such characteristics include, among others:

a) surface roughness or waviness;

b) color;

c) dimensional tolerances;

d) mechanical, chemical, electrical, thermal properties of laminate or product.

2) Product characteristics described by customer which are not considered good manufacturing design for reinforced plastics. These include:

a) product dimensional tolerances not capable of being held in manufacturing:

b) product mechanical and chemical requirements not capable of being met by materials of construction;

c) sharp molded corners and edges;

d) undercuts or absence of positive draft.

It is a function of the estimating group to define those items which are not clearly specified by the customer and to suggest design modifications in accordance with good manufacturing practice.

Moreover, the design modifications and choices of tools and processes which may result in cost savings to the customer should be described. For example, if a customer requests a quota-

tion on 500 units of a particular product which is estimated at $4 per part plus $5000 for matched-metal tooling, and $7 per part with $2500 of vacuum-bag-molding tooling, the total cost to the customer would be $7000 (matched-metal molded) or $6000 (vacuum-bag molded). Although the customer's immediate requirements would favor vacuum-bag molding, a subsequent requirement for 500 additional parts would favor matched-metal-molded parts. Such information should be pointed out to the customer so that he may select the process which will be most advantageous to him. All other factors pertinent to an intelligent decision such as comparative tool deliveries, production rates, and product specifications should also be discussed.

Qualifying estimates to customers as completely as possible can be a most important factor in establishing and maintaining a satisfactory customer-fabricator relationship, and in avoiding costly and time consuming delays after the customer has placed his order.

Purposes and use of forms

The use of estimating forms to collect and preserve estimating data can be of great value in the preparation of good estimates. The illustrated estimating forms each fulfill a distinct and necessary function in accomplishing this objective.

Information: Forms 150-A1 at right, and 150-A2, p. 140, typify the method of collecting information for preparation of estimates. Each customer inquiry for which the sales function wishes to make a quotation requires a separate estimate request form to be prepared, identified by a distinctive inquiry number, and transmitted to the estimating function for processing.

The forms, for the most part, are self-explanatory. Paragraph 11 on form 150-A2 refers to forms used for transmitting historical cost information. Such forms decrease the delays caused by frequent stoppages during the preparation of estimates in order to gather additional information which Sales could have obtained originally if they had been aware of what data were needed. Of course, such data are normally accompanied by drawings and/or specifications supplied by the customer.

Calculation: Calculations of area, weight, volume, perimeter, density, etc. define the ultimate amounts of materials needed. In view of this, the following three rules should be observed:

1) Show all calculations, including formulas and mathematical processes.

2) Have all calculations checked by a responsible independent source.

3) Preserve all calculations as an integral part of the estimate.

To assure that calculations are preserved, estimate calculations are performed on form 150-B, p. 141.

Sketches should be made of the part to aid in visualization. (See Fig. 1, p. 136). From such sketches, the processing operations required to manufacture the product become apparent. Also, possible difficulties with respect to manufacture such as sharp radii, reverse flanges, negative draft, accessibility of different areas of the part to the operators, etc., are more easily seen and can be taken into consideration in estimating labor requirements, or called to the customer's attention so that he may make appropriate design modifications.

Sketches are valuable in obtaining estimates from outside vendor sources on items such as molds and fixtures not usually manufactured in the plant. Also, while an engineer may feel more at home with a conventional orthographic drawing, the isometric

(To page 140)

ESTIMATE REQUEST FORM

Form 150A-1 (Rev. 4/56)

LL. INQ. NO 6199

Date Inq. 1.Received	1-10-57	Date Bid 2. Due	1-30-57	Date to 3. Estimating	1-11-57

4. Customer: XYZ Company

5. Description of what customer wants: Tank — approx. 36"x15"x25" deep with ½" wide exterior flange on open end. T. thickness 0.100±0.015" 2° draft O.K. all sides. QUANTITIES: 100

6. Does Customer Specify any delivery requirements? If yes, describe: Must have all parts by end of April, 1957

7. Does product require:	YES	NO	Describe:
Special chemical resistance properties		✓	
Thermal Resistance Properties		✓	
Electrical properties		✓	
Fire resistance properties		✓	
Other	✓		exterior surface ready for prime and paint

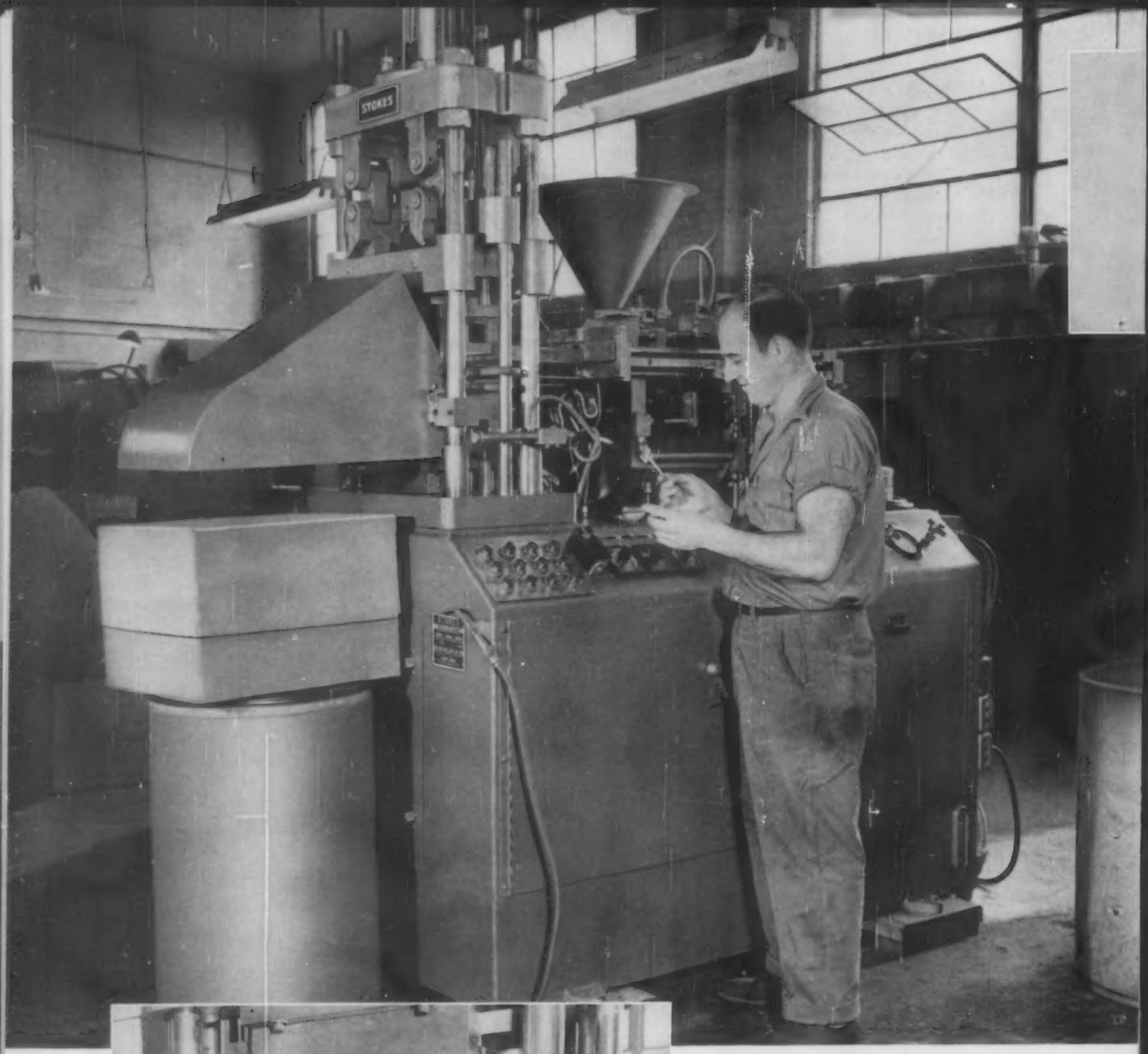
8. Describe dimensional requirements of product (thickness tolerance, critical dimensions etc.) Commercial tolerances — customer will furnish manuf. dwgs. for requote prior to purchase

9. List specs. & dwgs. called out by customer.	Enclosed YES	NO	FOLLOW
None			

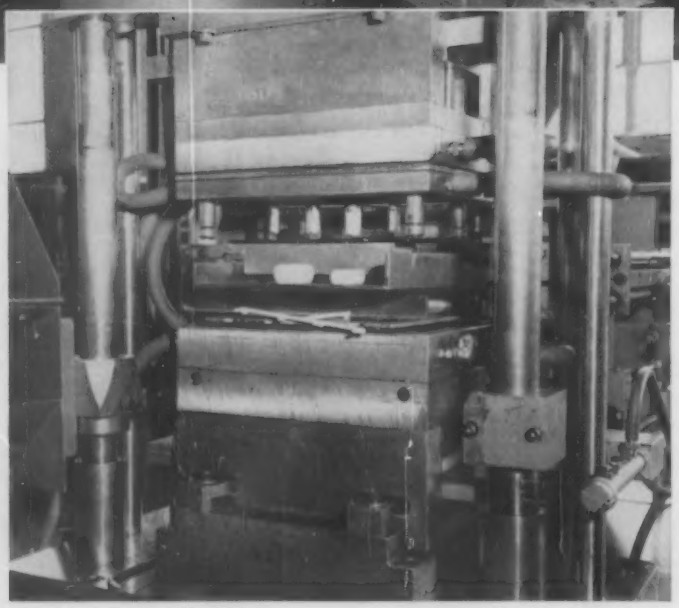
10. What kind of finish does customer require?

Customer expects some minor pinholing in exterior surfaces. Sandblasted surfaces O.K., interior surfaces not critical regarding surface condition. Pigmented gelcoat on exterior surfaces (Lt Gray) (Customer will finish with Lt Gray primer and enamel.)

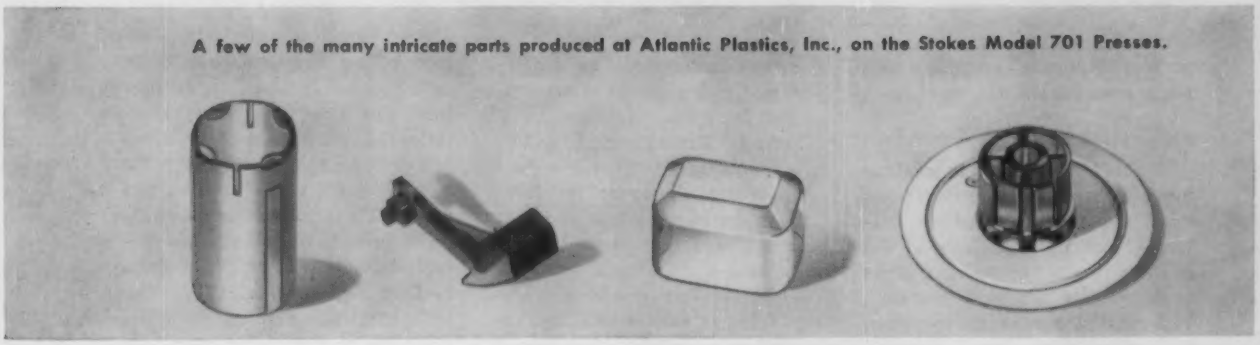
A1



Foreman Michael R. Valentine makes production inspection of parts produced on one of the Stokes Model 701 Automatic Injection Molding Presses at work in the Stamford, Connecticut plant of Atlantic Plastics, Inc.



Automatically separated parts and runners are pushed (not blown) from the die area of the Stokes Model 701.



A few of the many intricate parts produced at Atlantic Plastics, Inc., on the Stokes Model 701 Presses.

Atlantic Plastics, Inc., relies on Stokes Model 701 presses for lower cost production of precision parts...

Fully automatic injection presses enable this well known custom molder to produce a variety of intricate parts at low prices.

At the Stamford, Connecticut plant of Atlantic Plastics, Inc., four Model 701 Stokes automatic injection molding presses have been installed and two more are scheduled for early delivery. Atlantic Plastics was one of the first companies to successfully mold nylon — and are nationally known today for their ability to handle all types of thermoplastic resins.

Joseph E. Benoit, President and General Manager, when asked why Stokes presses were selected, stated "These machines will help us maintain our reputation for quality molding, while at the same time affording our customers lower prices for the injection molded parts they buy from us."

One of the major operating advantages of the Stokes 701, 2-ounce press, is the simplicity of the tooling required. From a practical standpoint, the small simplified mold costs less . . . enables faster set-up and changeover . . . provides higher uniformity and quality of the finished product. Thus, a 701 can produce lower cost parts through less labor, faster cycles, and higher efficiency.

The Stokes Model 701 incorporates the Stokes patented ejection system which positively clears all parts and runners from the die . . . assuring *continuous* automatic operation. Secondary protection is provided by use of the more common low-pressure close. It is a complete, self-contained molding plant. Its vertical design saves floor space . . . permits sorting of parts and separation of sprues and runners . . . facilitates mold set-up.

Write to Stokes today for your copy of literature describing the Model 701 2-ounce fully automatic injection molding press—ask for a Stokes Production Analysis on your own parts.

Plastics Equipment Division
F. J. STOKES CORPORATION
5546 Tabor Road, Philadelphia, Pa.

STOKES

sketch is much more readily grasped by shop operators and other non-engineering personnel.

Material bills

The material needed to produce a product unit may be developed by applying waste allowance factors to the net materials in the finished product to arrive at gross requirements for each material. The gross amounts must be priced to arrive at the total material cost allowance for the product. The net material amounts are developed on a unit-area basis. A layup diagram is sometimes included in the calculations.

The development of waste factors is accomplished during the calculations. Waste is considered excess material required over and above material in the finished product. Allowance for rejects is not considered part of the waste allowance, and is not included in the gross material allowance. Reject material allowances are discussed later on.

Material wastes come from two main sources:

1) Waste allowance for trim: This is the excess material which extends beyond the trim lines of the part.

2) Waste allowance for processing: This is excess material required for cutting odd-shaped patterns, materials lost during transfer from one container to another, material (such as resin) removed from the layup during molding, etc.

Waste factors may be classed into 1) reinforcement waste factors which apply to cloth, mat, roving, or other forms of reinforcements and their additives such as binders, 2) resin waste factors which apply to resins, fillers, pigments, catalysts, promotors, and other resin additives, and 3) miscellaneous waste factors, which apply to core materials, hardware, and other items not directly related to either the reinforcement waste or the resin waste. These waste factors may be developed by empirical formula based on historical job data, or they may be computed for the specific job being estimated on the basis of the detailed plan for producing the item. The latter is preferable if the computations required to develop the waste allowances are not overly complex.

In addition to raw materials which actually go into the product, certain key supplies are considered raw materials. These include films used in vacuum bag molding, such as polyvinyl alcohol or polyethylene, vacuum bleeder materials applied over the part during vacuum bag molding to promote excess air and resin removal, and boxes or crates for packaging.

Vendor services needed in manufacturing are also included in material bills.

Form 150-C, p. 142, is used in estimating material bills. This form includes a check list of normally used materials to remind the estimator to include all material items.

ESTIMATE
REQUEST FORM

Form 150A-2 (Rev. 4/56)

LI. INQ. NO. 6199

11	Have we quoted this product or modification during the past year, or have we previously made product? no If yes list below and forward form #206 if available, or Post Mortems & B/Ms.
	Prev. Job &/or Inq. Nos: none
12	Proposed credit & terms: Credit being checked by accounting
13	Profit to be applied (based on Selling Price): 10 %
14	Additional Comments: 1. Price and delivery not firm — we will requote on manuf. dwgs early next month 2. Customer anticipates annual requirement of about 500 tanks for next 5 years, in lots of 100. 3. Suggest mat and general purpose resins. 4. Customer will pick up, unboxed, in lots of 25 5 Quote tools separately.

15 Screened & Accepted by:	JB	1-10-57	A2
	Sales	Date	

Labor bills

Before starting the labor bill, the estimator must have a fairly complete idea of the production methods to be employed. The manufacturing techniques and the sequence of operations are determined by the nature and quantity of the product, and by the manufacturing operations used by the fabricator.

The approach to estimating labor is complicated by the estimator's concept of a labor unit. To illustrate this, consider a person dividing 15,000 marbles into lots of ten. Here is a counting operation to be repeated 1500 times.

Estimator number one calculates that counting one marble takes 0.3 second. He therefore estimates 4500 sec. or 75 min. are required for the job.

Estimator number two also con-

siders that counting one marble requires 0.3 second, but he considers that the marbles must be carried to a place where they are to be divided into lots of ten. He also considers that after being divided into lots of ten, the marbles must be packaged (in bags, for example) and delivered from the work area to a shipping or further processing area. Allowing ten minutes for materials handling and 5 sec. for packaging each lot, he estimates that $75 + (1500 \times 5/60) + 10 = 210$ min., or 0.84 sec. per marble are required.

Estimator number three computes the labor on the same basis as number two, except that he figures that the operator takes two 10-min. breaks during the job. This additional 20 min. paid time makes the total estimated labor time 230 min. or an average of 0.92 sec. per marble.

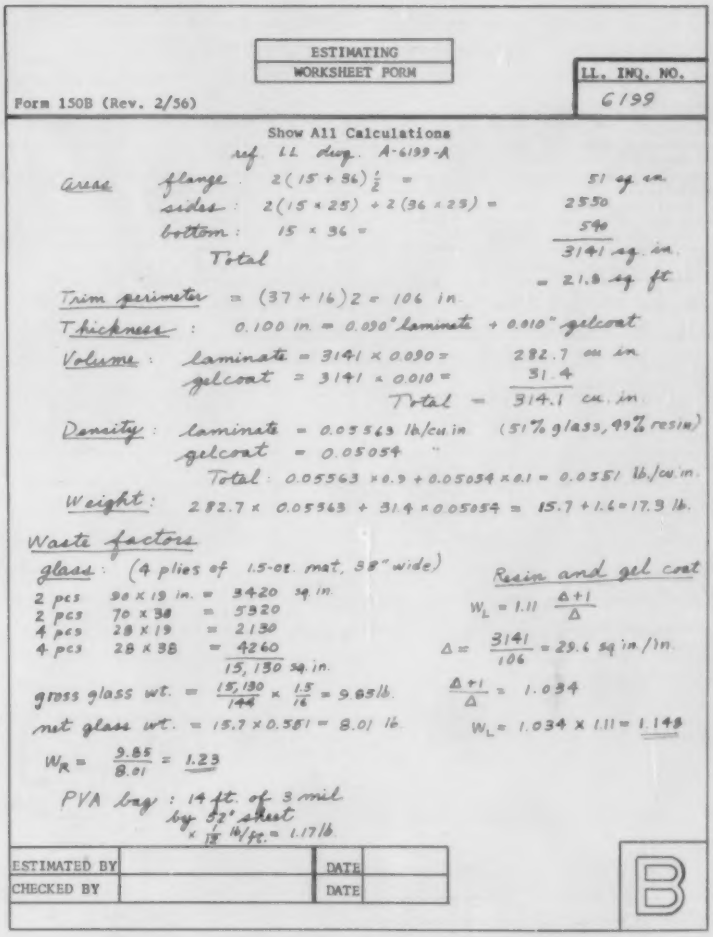
Estimator number four figures the labor in the same manner as estimator three. However, he feels that a "start-up load" should be considered. He figures that the first ten marbles will take 10% longer to sort than the last, and that the operator will arrive at greater proficiency as he goes along. His estimate, therefore, allows $(200 \times 1.05) + 10 + 20 = 210 + 30 = 240$ min., or 0.960 sec. per marble.

Estimator number five assumes that operator errors will result in rejects by the customer of 5% of the lot, which will have to be subsequently re-sorted and re-packaged. He therefore allows $240 \times 1.05 = 252$ min., or 1.008 sec. per marble.

Estimator number six envisions a sorting and packaging device which does the whole job, including machine loading in 120 min., or 0.48 sec. per marble.

Thus, six estimators have come up with six very different labor estimates. It is obvious that a common basis for estimating labor must be reached.

To accomplish this the estimated labor unit is defined as the total amount of charged labor time required to fabricate one completely packaged product unit after all "bugs" have been worked out, utilizing those fabrication tools defined by the estimate. Additional labor allowances for start-up load and rejects are taken into consideration at a later point in the estimate.



ESTIMATING WORKSHEET FORM

Form 150B (Rev. 2/56)

LL. INQ. NO. 6199

Show All Calculations

ref. LL dwg. A-6199-A

Areas: flange: $2(15 + 36)\frac{5}{8}$ = 51 sq. in.
sides: $2(15 \times 25) + 2(36 \times 25)$ = 2550
bottom: 15×36 = 540
Total 3141 sq. in. = 21.8 sq. ft.

Trim perimeter = $(37 + 16)2$ = 106 in.

Thickness: 0.100 in. = 0.090" laminate + 0.010" gelcoat

Volume: laminate = 3141×0.090 = 282.7 cu. in.
gelcoat = 3141×0.010 = 31.4
Total = 314.1 cu. in.

Density: laminate = 0.05563 lb/cu in. (51% glass, 49% resin)
gelcoat = 0.05054 "
Total: $0.05563 \times 0.9 + 0.05054 \times 0.1 = 0.0551$ lb./cu. in.

Weight: $282.7 \times 0.05563 + 31.4 \times 0.05054 = 15.7 + 1.6 = 17.3$ lb.

Waste factors

glass: (4 plies of 1.5-oz. mat, 38" wide)

2 pcs	30 × 19 in.	=	3420 sq. in.
2 pcs	70 × 38	=	5320
4 pcs	28 × 19	=	2130
4 pcs	28 × 38	=	4260
			15,130 sq. in.

gross glass wt. = $\frac{15,130}{144} \times \frac{1.5}{16} = 9.85$ lb.

net glass wt. = $15.7 \times 0.581 = 8.01$ lb.

$W_R = \frac{9.85}{8.01} = 1.23$

PVA bag: 14 ft. of 3 mil by 52" sheet $\times \frac{1}{12} \times 14$/ft. = 1.17 lb.

Resin and gel coat

$W_L = 1.11 \frac{\Delta + 1}{\Delta}$

$\Delta = \frac{3141}{106} = 29.6$ sq. in./in.

$\frac{\Delta + 1}{\Delta} = 1.034$

$W_L = 1.034 \times 1.11 = 1.148$

ESTIMATED BY		DATE	
CHECKED BY		DATE	

B

Form 150-D, p. 144, is used to estimate labor. A labor operations check list is provided, serving the same purpose as the material check list on form 150-C. Labor operations are described in sequence, and number of men, time in minutes, and labor required in man-minutes estimated for each operation and totaled. All labor estimates are checked by one independent source (two if the total dollar value estimated is above a certain amount).

Space is also provided for an estimate of the average production rate. In addition to aiding the estimator in calculating delivery schedules, the average production-rate figure serves as a check on the labor estimate. It is obtained from the time required for the controlling elements in the sequence of operations—usually that part of the cycle in which the expensive molding tools are in use. In the sample form D (p. 144), for example, the mold is occupied during 39 min. of direct labor (from "clean mold" through "remove part"), and a 40-min. cure time seemed reasonable for this tank, though it might be less. Ergo, in a 480-min. day, 6 pieces could be made with one set of tools. The operator carries out steps 2, 4, 7, and 11, requiring 81 man-min.; this checks with the estimated tool tie-up of 79 minutes.

Extra labor in start-up

In estimating labor requirements, one must take into account the fact that the operators gain efficiency with practice; steady improvements may sometimes be

ESTIMATING
BILL OF MATERIALS

LL INQ. NO. 6199

Form 150C (Rev. 2/56)

1 cloth	4 resin	7 filler	10 PVA	13 bleeder	16 promoter
2 mat & roving	5 core	8 finish	11 vendor	14 binder	17 pigment
3 gel-coat	6 adhsve	9 hrdwre	12 pkging	15 catalyst	18

CHECK ALL ITEMS USED ABOVE — SHOW MATERIAL CODE # FOR ALL ITEMS ON BILL

CODE #	MATERIAL DESCRIPTION	NET AMT.	WASTE INC.	GROSS AMT.	MAT'L. PR.	COST
2	1.5-oz. mat (38" wide)	8.01 lb.	1.23	9.85 lb.	$0.60	$5.91
3	light gray gelcoat	1.60 lb.	1.148	1.84 lb.	0.49	0.90
4	general purpose resin	7.69 lb.	1.148	8.83 lb.	0.345	3.05
10	14 ft. of 3 mil x 52 in. PVA	—	—	1.17 lb.	1.70	1.99
15	MEK peroxide (2%)	0.15 lb.	1.148	0.17 lb.	1.80	0.31
16	cobalt naphthenate (1%)	0.08 lb.	1.148	0.09 lb.	0.53	0.05

COMMENTS (FOR PROJECT ENGINEER'S INFO.) — 17.53 lb. — 21.95 lb.

$ 12 21
TOTAL UNIT MATERIAL ALLOWANCE

ESTIMATED BY HT DATE 1-13-57

C

realized even after several thousand duplicate pieces have been made. This increase in efficiency is predictable from formulas whose graphs are known as "learning curves."

The estimator visualizes the various labor operations being performed after the job has been "debugged," i.e., when learning is complete and the time per piece has become constant. After estimating the labor required to make the product on this basis, the estimator can then utilize learning curves to calculate the allowances to be made for the learning period (start-up load).

Figures 2, 3, and 4, p. 150, are actual learning curves drawn from performance data on three different reinforced plastics manufacturing jobs involving different manufacturing methods. They are plotted on logarithmic graph paper because it has been found that the learning period can usually be well represented by a straight line on such paper. The x coordinate represents the number of parts produced; y stands for the cumulative average labor unit over the production period from the first to the xth piece, expressed as a multiple of the final constant labor unit, which is assigned unit value. Because y is a ratio, it approaches unity as x grows indefinitely large, and the straight line becomes curved, gradually becoming more nearly horizontal. The equation of the linear section is

$$y = A\,x^{-n} \text{ (for } x \leq x_1) \qquad \text{Eq. 1}$$

where y = the cumulative learning-curve factor = cumulative labor for x units divided by x times the long-time labor unit. A = a constant characteristic (like n) of the system; it is equal to the labor used in making the first piece divided by the long-time labor unit.

n is a fraction, generally larger than 0.1.

x_1 = a transition value discussed below.

This relationship may also be written in its logarithmic form:

$$\log y = \log A - n \log x \qquad \text{Eq. 2}$$

The values for x_1, A, and n vary, depending upon the size, shape, and composition of product, and upon the nature of the processing operations. A series of learning curves based upon historical data have been prepared to define the relationships between x and y for various types of products and processing operations. These curves are used to select the proper labor learning curve factor for each job estimated. In general, all curves exhibit the following similarities regardless of size, shape, composition, or processing operations:

A lies somewhere between 3.0 and 40.0, usually between 4.0 and 15.0.

n lies somewhere between 0.16 and 0.51.

x_1 lies somewhere between 10 and 10,000, usually between 30 and 200 for hand layup jobs and between 3000 and 5000 for press jobs.

Since the unit labor allowance estimated on form 150-D does not consider start-up load, the learning curve factor must be applied to the summary form. To do this, the proper curve is selected according to the nature of the product and processing. y is then read from the curve for the corresponding value of x, the number of product units (including rejects) to be produced. The number of labor units required to produce the quantity of products estimated = $x\ y$.

After a certain number of product units have been made, no further improvement in technique is realized; "learning" is complete. The labor unit becomes constant at the long-time value, and the *cumulative* average labor unit begins to approach this value, too. At this point, x_1, the logarithmic relationship ceases to apply and a hyperbolic form describes

Clear protection for products

These products are "skin packaged" in Flex-O-Film B, a plastic sheeting made by Flex-O-Glass, Inc., Chicago 51, Ill., from Tenite Butyrate. Eversharp-Schick razors made by Eversharp, Inc., New York City. Pinking shears made by Town House Products Co., Inc., Chicago 12, Ill.

Thanks to modern "skin packaging," manufacturers can protect their products and display them clearly at the same time.

The tough "skin" used on the above packages is made of sheeting extruded of Tenite Butyrate plastic. Virtually invisible, this sheeting conforms to the contours of the product and holds it securely to the cardboard backing. It shows the product clearly, yet protects it from dirt and scratches. Through "skin packaging" several related items also can be packaged together for combination offers and special promotions.

Tenite Butyrate and the other plastics made by Eastman—Tenite Acetate and Tenite Polyethylene—play important roles in packaging. If you serve the packaging industry with either extruded or molded plastic products, call on Eastman for more information on the versatile Tenite plastics. **EASTMAN CHEMICAL PRODUCTS, INC.,** *subsidiary of Eastman Kodak Company,* **KINGSPORT, TENNESSEE.**

Information regarding Tenite also can be obtained from local representatives listed under "Plastics—Tenite" in the classified telephone directories of the following cities: Atlanta, Chicago, Cleveland, Dayton, Detroit, Houston, Kansas City, Leominster (Mass.), Los Angeles, New York City, Portland (Ore.), Rochester (N. Y.), St. Louis, San Francisco, Seattle and Toronto—elsewhere throughout the world, from Eastman Kodak Company affiliates and distributors.

1932—EASTMAN'S 25TH YEAR IN PLASTICS—1957

TENITE
BUTYRATE
an Eastman plastic

MACHINERY FOR PLASTICS AND RUBBER

the rest of the curve. From the definition of y and the logarithmic relationship (Eq. 1), it can be shown that the coordinates of the transition point are given by

$$x_1 = A\,(1 - n)^{\frac{1}{n}} \qquad \text{Eq. 3}$$

$$y_1 = A\,x_1^{-n} \qquad \text{Eq. 3A}$$

The hyperbola giving the value of y for values of x greater than x_1 has the equation

$$y = (x+C)/x = 1+C/x,\ (x>x_1) \qquad \text{Eq. 4}$$

where C is a constant given by

$$C = A\,x_1^{1-n} - x_1 \qquad \text{Eq. 5}$$

The slope of the learning graph is often expressed percentage-wise as the ratio of two successive y values corresponding to a doubling of x. The equation for the "percentage" p of the learning curve is

$$p = 100\,(2^{-n}) \qquad \text{Eq. 6}$$

The curve may be fitted to the direct labor data, after the x,y pairs have been computed from the records on a particular job, by any of a number of methods. A rough decision must be made as to where the graph begins to deviate from linearity, since that determines what points are to be included in the calculations. Sticklers may wish to recalculate if the fitted graph has a transition point beyond some of the excluded points. Practically, it will usually suffice to draw in the linear part by eye, then measure the slope and read off the intercept. In Fig. 3, for example, the intercept A is 10.9. The slope was calculated from that number and from the value of $y(=2.06)$ at $x = 100$, as follows:

$$\text{slope} = \frac{\log y_2 - \log y_1}{\log x_2 - \log x_1} = \frac{0.314 - 1.038}{2.000 - 0.000} = -0.362 \qquad \text{Eq. 7}$$

Thus $n = 0.362$, and the equation of the line is

$$y = 10.9\,x^{-0.362} \qquad \text{Eq. 8}$$

Since $2^{-n} = 0.828$ in this case, this is an 82.8% learning curve. Any other points along the line could have been used; they should be well separated, for accuracy's sake.

Interpretation

It is a striking fact that in a large number of jobs in which direct-labor records have been kept from the beginning, all have been well fitted by a composite graph of this type. The "learning" seems to be retained from order to re-order, unless very long time lapses occur between. In all three of the jobs whose graphs appear in Figs. 2, 3, and 4, (p. 150) there were several re-orders. In some instances, different operators, new to the particular job, took over the work. In spite of this, there are no serious discontinuities in these graphs that would indicate a regression to the original start-up status. This finding implies that the so-called "learning" is not so much a matter of operator training or dexterity as a matter of overcoming technical problems or "bugs" and developing an efficient *modus operandi* that can be transmitted by instruction from one operator to another and can be recorded for future reference.

Another finding emerging from the examination of past learning curves is this: the simpler, the more routine and standardized the elemental operations, the slower the learning and the smaller the ultimate improvement. This is to be expected, since in standardizing operations an effort is made to find good ways of performing them. Thus the learning period in making the press-molded housing extended over 6860 units, much longer than either the small vacuum-bag molding or the hand layup job. The cowl was so simple a job that it was learned very

ESTIMATING LABOR BILL

Form 150D (Rev. 2/56)

LL INQ. NO. 6199

	Check below all operations used. Show labor Code # for all operations on bill.	
1	mat. prep.	✓
2	layup	✓
3	inspection	✓
4	trim	✓
5	holes	
6	machine	
7	rough	✓
8	bond	
9	mech. ass'y.	
10	salvage	
11	surface sand	✓
12	prime	
13	paint	
14	neoprene coat	
15	package	
16	handling	
17	unassd. time	
18	supervision	✓
19		
20		
21		
22		
23		
24		
25		
26		
27		
28		
29		
30		
31		
32		
33		
34		
35		

CODE #	OPERATIONS (IN SEQUENCE)	NO. MEN	TIME MIN.	MAN MIN.
1	cut set of patterns	1	8	8
1	make 100 x 84 in. bag	1	5	5
2	mix resin	1	3	3
2	clean mold	1	4	4
2	spray mold release	1	3	3
2	spray gelcoat	1	6	6
2	layup part	1	14	14
2	bag	1	7	7
2	remove part	1	5	5
3	inspect	1	2	2
4	trim part	1	20	20
7	sand blast outside	1	8	8
11	sand out inside bag wrinkles	1	10	10
3	final inspection	1	3	3
18	supervision	1	12	12

1 man makes 6 pcs. in 1 day (plus mat prep.) (inspection + supervision)

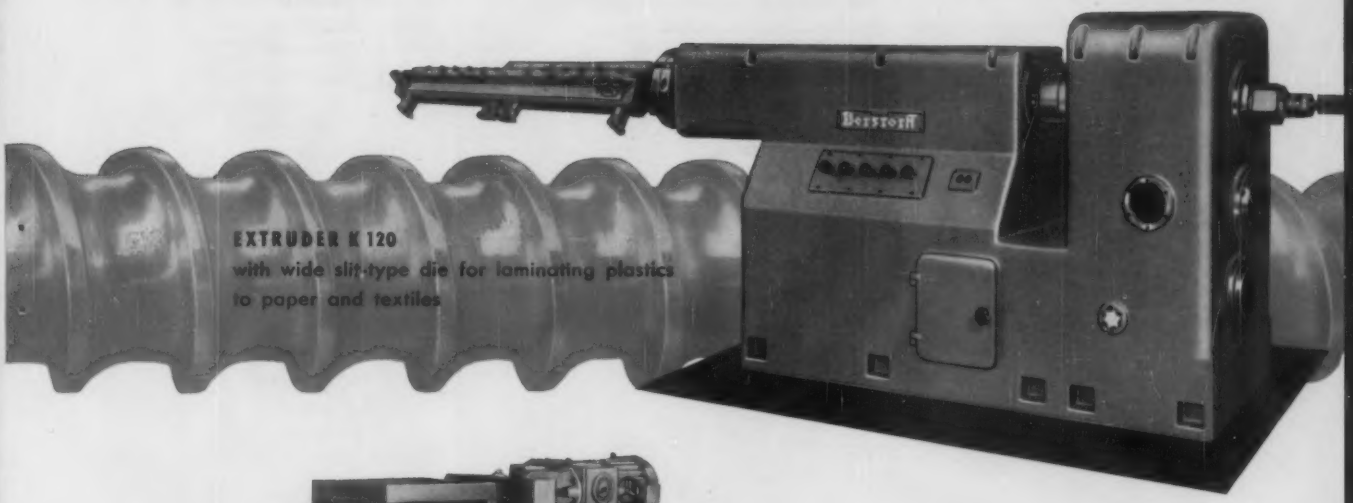
Average production rate

Total labor allowance: 111 man min. / 1.85 man hours

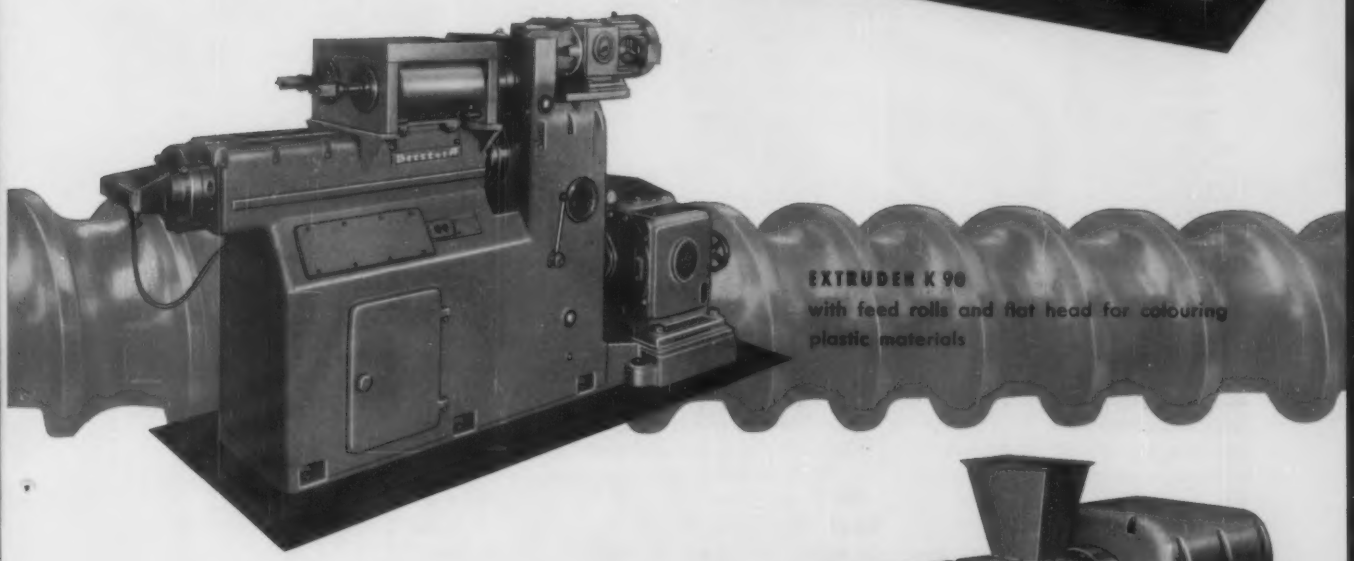
ESTIMATED BY	H.T.	DATE	1-13-57
CHECKED BY	F.W.S.	DATE	1-13-57
CHECKED BY		DATE	

D

MACHINERY FOR PLASTICS AND RUBBER



EXTRUDER K 120
with wide slit-type die for laminating plastics to paper and textiles



EXTRUDER K 90
with feed rolls and flat head for colouring plastic materials

EXTRUDER K 150
with 45° cross head for covering large diameter cables

We supply for the plastics industry:
Calenders with 2 – 4 rolls, mills and AUMA continuous laminating machines, extruders 30 – 460 mm of screw diameter, including all accessory equipment

Sole Representatives in USA:
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Form 150E (Rev. 3/56)

ESTIMATING
Engineering and Tooling Bill

LL Inq. No. 6199

Code No.	Description	Check One O.Y.	Check One L.L.	Deliv. Wks.	Man Hours	Rate	Labor Cost	Matl. Cost	Amort. Tool Cost	Non-Amort. Tool Cost
5	Male wood pattern (inside)		✓	1	80	$4.00	$320.00	$ 55.00	$	$ 375.00
6	Female epoxy laminate bag mold with hold-down ring + stand		✓	1	70	4.00	280.00	157.00		437.00
8	mat cutting template		✓		4	4.00	16.00	2.00		18.00
11	trim jig (for radial saw)		✓	½	12	4.00	48.00	6.00		54.00
14	tool setup		✓		2	4.00	8.00		8.00	
									$ 8.00	$ 884.00

Check all item used below. Show tooling code number for all items on bill.

1	Engrng.		8	Cut. Temp.	✓
2	Design		9	Insp. Fix.	
3	Drawings		10	Drill Jig	
4	Handbks		11	Trim Jig	✓
5	Patrns	✓	12	Mach. Fix.	
6	Molds	✓	13	Ass'y Jig	
7	Pr.Scr.		14	Set-up	✓
			15	Testing	

2½ wks — Est. Deliv.

Amort. Total Tooling — Non-Amort. Allowance

ESTIMATED BY	A.T.	DATE	1-3-57
CHECKED BY	F.W.S.	DATE	1-3-57
CHECKED BY		DATE	

E

quickly. The degree of standardization in reinforced molding operations is difficult to measure; so is their complexity; it is likely, too, that there are other factors that influence the learning period and degree of learning. But this finding can be of real help in estimating the start-up load when past data are scarce.

Using the learning curve

In making the estimate, a learning curve from that completed job most like the one to be estimated is used. As an illustration, the graph of Fig. 3 is applied to the sample job of making the tank of Fig. 1 (p. 136). The long-time labor unit was estimated to be 111 man-min., and the number of tanks desired is 100. Assume three pieces will be rejected. From Fig. 3, the cumulative learning-curve factor for $x = 103$ is 2.04. It can be expected, therefore, that the hundred tanks are actually going to require an average of about $111 \times 2.04 = 226$ man-min. per tank. This estimate is probably high, since the tank is simpler to make than the rather complicated radome of Fig. 3; but it shows that the start-up load, particularly on small quantities, may be very large. Even in the simple cowl job, in which learning was completed with the 12th piece, the value of y for $x = 103$ was 1.12—a 12% increase over the long-time rate.

Use of empirical formulas

In order to simplify and expedite the preparation of estimates, empirical formulas have been developed to apply to various phases of labor and material estimates. Examples of some of these follow.

Waste factors:

$$W = k_1 + k_2/\Delta \qquad \text{Eq. 9}$$

where W = a waste factor by which the *net* material in the product is multiplied to get the gross material allowances;

Δ = ratio of part area to part perimeter, sq. in./in. or sq. ft./ft.;

k_1 and k_2 are constants that reflect the types of material and the methods of processing.

Cost of manufacture for laminate molds:

$$\text{Cost} = k_3 + k_4 A + k_5 P \qquad \text{Eq. 10}$$

where A = the part area;

P = the trimmed perimeter of the part;

k_3, k_4, and k_5 are constants.

A similar equation, differing only in the values of the constants, applies to the cost of making preform screens.

Cost of manufacture for roving preforms:

$$\text{Cost} = k_6 M + k_7 M/Q + k_8 \qquad \text{Eq. 11}$$

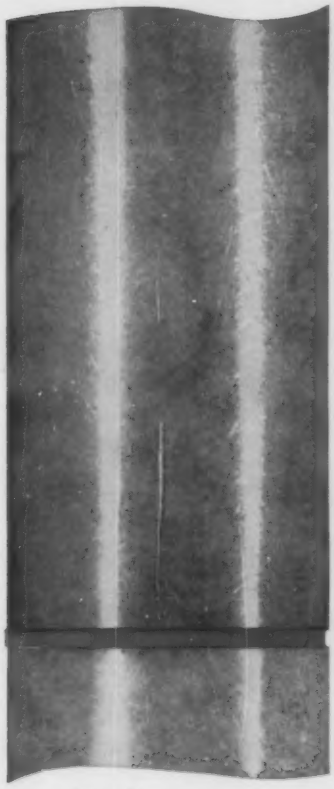
where M = weight of preform;

Q = the number of preforms per cycle;

k_6, k_7, and k_8 are constants.

These examples typify the many useful formulas that can be developed and used in estimating. It must be remembered in using such formulas, however, that important time-influencing factors may have been averaged out in deriving the formulas. Excessive product bulk, complex contours, special dimensional and appear-

18 MONTHS OF FLORIDA EXPOSURE



CONTROL

PARAPLEX P-444:

no perceptible erosion, discoloration, loss of translucency, or reduction of gloss.

CONTROL

PARAPLEX P-433:

significantly better in all respects than conventional polyester but definitely inferior to PARAPLEX P-444.

CONTROL

CONVENTIONAL POLYESTER:

severe erosion resulting in extensive fiber exposure, loss of translucency and gloss with marked discoloration.

How to make *weather resistant* glass-fiber reinforced materials

These test samples demonstrate graphically the outstanding resistance of panels made from PARAPLEX® P-444 to erosion and discoloration even after prolonged outdoor exposure under the severe test of Florida climate. Glass-fiber reinforced materials made with PARAPLEX P-444 have *proven* resistance to the deteriorating effects of heat, rain, wind-blown dust, oxidation and ultraviolet light. Exceptional performance results because in curing PARAPLEX P-444 a cross-linked copolymer is made by the reaction of an unsaturated polyester with both methyl methacrylate and styrene. PARAPLEX P-444 provides a high degree of transparency because, when cured, its index of refraction is close to the index of refraction of the glass fibers.

Write for complete details on PARAPLEX P-444 and other Rohm & Haas polyester resins.

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Representatives in principal foreign countries

ESTIMATING
SUMMARY AND APPROVAL FORM

Form 150F (Rev. 3/56)

LL INQ. NO. 6199

Area sq. in.	3141	MAT. ALLOW.	$ 12.21	LABOR AL. MAN MIN.	111	TOOL. & ENG. ALLO.		AM. N-AM.	8.00 884.00
Area sq. ft.	21.8	OVERHD. FACTOR	2.15	G & A FACTOR	1.07	PROFIT FACTOR	1.11	LABOR RATE	$ 0.03/m.m.
Thickness inches	0.100								
Volume cu. in.	314.1								
Density #/cu. in.	.0551								
Wt. Lam. lbs.	17.3								
Wt. Fitgs. lbs.	—								
Total Wt. lbs.	17.3								
Trim perim. ins.	1.06								
△ sq. in. per in	29.6								
W R	1.23								
W L	1.148								

QUANT.	REJ. ALL.	I MATERIAL S.P.	LAB. UNITS	LAB. UNITS ÷ QUANT	II LABOR S.P.	III ENG. & TOOL S.P.	IV TOTAL S.P.
100	1.03	$ 14.95	204	2.04	$ 17.32	$ 0.09	$ 32.36
		$			$	$	$
		$			$	$	$
		$			$	$	$

I MATERIAL SELLING PRICE EQUALS MATERIAL ALLOWANCE x REJECT FACTOR x PROFIT FACTOR x G & A FACTOR
II LABOR SELLING PRICE = LABOR ALLOWANCE x LABOR RATE x OHD. FAC. x G & A FAC. x PROFIT FAC. x LABOR UNITS ÷ QUANTITY
III FOR AMORTIZED ENG. AND TOOL ONLY!! ENGINEERING & TOOLING ALLOWANCE x G&A FACTOR x PROFIT FACTOR ÷ QUANTITY.
IV TOTAL SELLING PRICE EQUALS I PLUS II PLUS III.

TOOLING (NOT AMORTIZED) EQUALS ENGINEERING & TOOLING ALLOWANCE x G&A FACTOR x PROFIT FACTOR $ 1050

TOOL DEL.	PART DEL.	PER WEEK STARTG.	WEEKS FROM ACC. OF ORDER	APPROVED BY
2 ½	25	4		C.N.
WKS. FROM ACC. of ORD.				PLANNING 1-17-57 DATE

COMMENTS AND EXCEPTIONS:
Estimate per dwg. A-6199-A with surfaces prepared for finish as specified on form 150-A-1 (item 10)

$ 4286 MAX. EST. TOTAL

ESTIMATED BY H.T. DATE 1-13-57 O.K F.W.S 1-17-57

ESTIMATE APPROVED ✓ DISAPPROVED FOR QUOTATION

SIGNED J. S. L. DATE 1-18-57

F

Table I: Information for form 150-F

Item	*Source*	*Derivation*
Material allowance	Form 150-C	—
Labor allowance	Form 150-D	—
Tooling and engineer-allowance	Form 150-E	—
Overhead	Company policy (% of direct labor cost)	Overhead factor = 1.00 + (0.01 × % overhead)
G & A[1]	Company policy (% of labor, overhead, and material)	G & A factor = 1.00 + (0.01 × % G & A)
Profit	Form 150-A2 (item 13)	Profit factor = $\frac{100 + \%\ \text{profit}}{100 - \%\ \text{profit}}$
Quantities	Form 150-A1 (item 5)	
Reject allowances	Historical data	Reject allowance factor = 1.00 + (0.01 × % reject)
Labor units	Learning curve	Labor units = labor learning curve factor × quantity × reject factor
Labor units—quantity	Form 150-F	

[1]G & A = general overhead and administrative expenses; this includes all overhead not bearing directly on manufacturing, plus administrative costs.

ance requirements, etc., can significantly increase the time required for the job over the time estimated from empirical formulas representing "standard" operations. Therefore product specifications should be carefully considered to determine the applicability of any such formulas. Labor estimates are best based on visualization of the operations relating to each product, but the empirical formulas can be effectively used for checking.

Reject allowances are normally made on the basis of historical experience for analogous jobs. Such allowances are usually based on shop averages rather than visualized contingencies.

Engineering and tooling bill

Before estimating for tooling and engineering, a considerable amount of preliminary data must be gathered. First, some idea of the customer's product potential must be obtained. For example, a customer may want to buy 100 units of a particular item. However, if the customer feels that this first 100 units is a pilot run, probably to be followed by substantial production orders, he may be willing to purchase more elaborate and expensive tools than 100 units warrant in order to achieve the lowest costs based on, for example, 5000 units. This type of information must be explored by the sales function before the estimator can make an intelligent estimate.

Second, the estimator must determine which tooling is to be fabricated in the shop and which tooling is to be fabricated by outside vendors. Convenience is gained if outside vendor tool quotes are requested on Reinforced Plastics Mold Data Sheets, obtainable from the Reinforced Plastics Div. of S.P.I. at a nominal cost.

After the type of tooling is selected, the various tooling and engineering items are estimated with respect to cost and delivery. If product and/or tool design are required, the cost and delivery of basic design, engineering stress analyses, preparation of drawings, reproduction of drawings, etc., must also be considered.

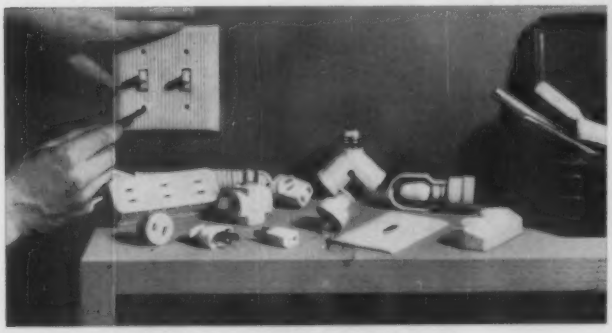
Form 150-E, p. 146, is used to

CYANAMID

PLASTICS NEWSFRONT

CYMEL* IN ELECTROSURGERY

High-frequency current flows between two sharp electrode tips in the 789 Bi-Active Coagulation Set used by physicians for removal of cervical cysts, tonsils and surface growths. The Birtcher Corp. of Los Angeles encases the electrodes in mineral-filled CYMEL Melamine Molding Compound because of its excellent insulating properties and smooth flow into the mold which simplifies accurate spacing of the tips. Handles and cord tips are molded of alpha-cellulose-filled CYMEL, also an excellent insulator. All surfaces are exceptionally hard, chip resistant and can be sterilized easily. *Trademark



MODERN TOUCH IN WIRING DEVICES

Home styling today favors light, cheerful colors. This note is carried out perfectly with wiring devices molded of ivory-colored BEETLE® Urea Molding Compound. Its hard, smooth surface resists discoloration and scratching, and safe dependable service is insured by BEETLE's excellent insulating properties.

WOOD CHIPS BUILD A WALL

These attractive panels are made of wood particles bonded with MELURAC® Melamine-urea Resin. This low-cost particle board has good warp resistance, flexural strength, moisture resistance and easy working and finishing properties. In addition to structural uses—walls, sliding doors, partitions, ceilings, subflooring, parquet flooring—it is ideal for furniture core and underlayment of decorative melamine laminates. MELURAC 304, developed expressly for this use, imparts no color and improves strength of the particle board.

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CYANAMID Plastics and Resins Division
MATERIALS FOR TOMORROW

prepare engineering and tooling estimates. This form does not provide spaces for itemizing tooling materials and labor for each individual tool. This is because empirical formulas are used to develop labor and material requirements for shop fabricated tools. If itemizing material and labor for tools is necessary, this is accomplished on forms 150-C and 150-D.

Space is provided on the form to show total costs of individual tools as either "amortized" or "non-amortized" costs. If the customer requires tooling to be listed separately, then tooling costs are shown as non-amortized. It is usual for product testing and tool setups to be amortized into the part prices.

As on forms 150-C and 150-D, form 150-E has a check list for the convenience of the estimator. All tooling estimate substantiating data, including outside vendor quotes, are included as part of the tooling estimate.

As in labor estimates, one independent checking source (two if dollar estimates exceed a certain figure) is required to check tooling and engineering estimates.

Summary sheet

In summarizing all the foregoing data, three basic types of information must be restated in short form for the prospective customer's understanding:

1) Price information;
2) Delivery information;
3) Definition of the product's dimensional, mechanical, chemical and visual characteristics.

The summarized estimate is prepared on form 150-F, p. 148. The left-hand column provides space for summarizing the dimensional data compiled during the initial calculations, plus important processing information such as raw material waste factors, trim perimeters, etc.

All prices are obtained by following instructions on form 150-F. The source and derivation of some of the items in the summary sheet are listed in Table I, p. 148.

Delivery data: Delivery data is completed from tool delivery data (form 150-E) and production

(*To page* 243)

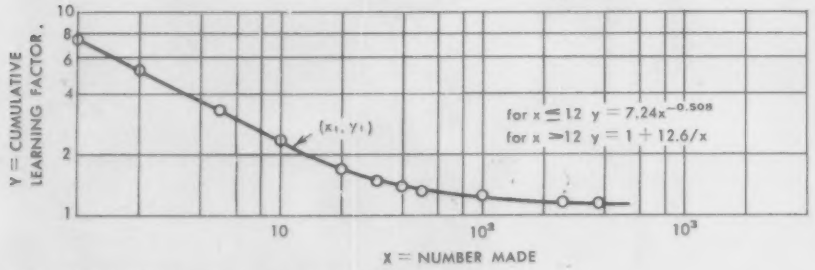


Fig. 2: Learning curve for a bag-molded aircraft cowl. Weight of part is about ½ pound

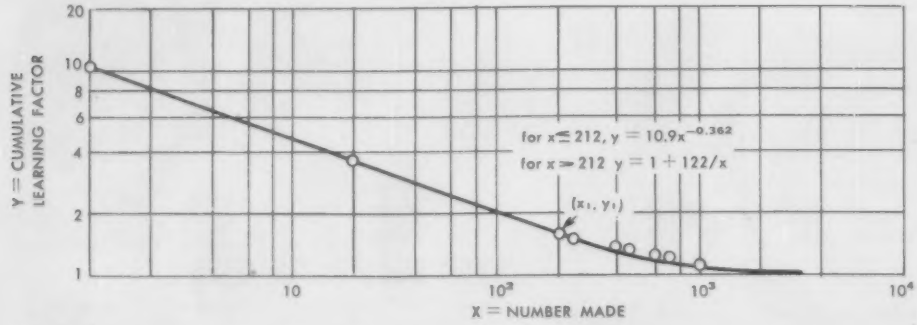


Fig. 3: Learning curve for a large radome, a complex cored structure with a total weight of about 115 pounds. Part was molded by the hand lay-up method

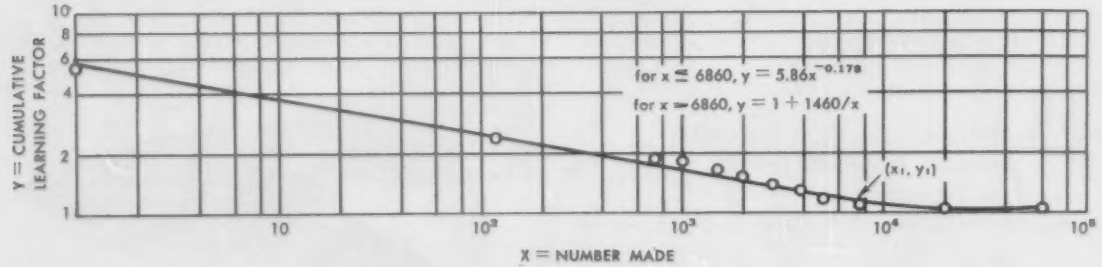


Fig. 4: Learning curve for a press-molded housing weighing about 1.5 pounds

Recent trends in photoelastic plastics

By M. M. Leven and R. C. Sampson**

Plastics are useful in stress analysis because their optical properties are directly related to the stresses imposed. The stresses may be "frozen" into the specimen, and the specimen may then be cut up for detailed analysis without changing the frozen stress distribution. The use of plastics in photoelasticity is traced from Celluloid to the epoxies, which now seem the best of all. With the proper hardener, a good balance between exotherm temperature and photoelastic sensitivity to stress can be obtained in the cured resin. Very complex structures can be built up and tested, and some interesting examples are given. These resins, in both solid and film form, provide the design engineer with a versatile tool for predicting behavior of all materials under load.

The photoelastic effect was first discovered in glass by Brewster in 1816. Fresnel, Neumann, Maxwell, and others, in the next few years, investigated the effect and determined the stress-optic relations which are the basis for photoelastic analysis as it is carried out today.

However, no practical photoelastic tests were made until more than 80 years later when Coker and Filon introduced Celluloid as a model material around the year 1900.

Ever since then, the advances in photoelasticity have been intimately connected with the introduction of new and better plastics for model materials. Thus, starting with glass we have advanced to Celluloid, and then to Bakelite glycerin phthalic anhydride and a host of other materials suitable for two-dimensional photoelastic tests.

Now, with the introduction of the technique involved in the method of "stress freezing" for three-dimensional tests, we have advanced from the Bakelite material to Fosterite styrene polyester, Kriston allyl ester, and more recently to the epoxy resins which show considerable promise for a number of important applications in the field of photoelastic stress analysis.

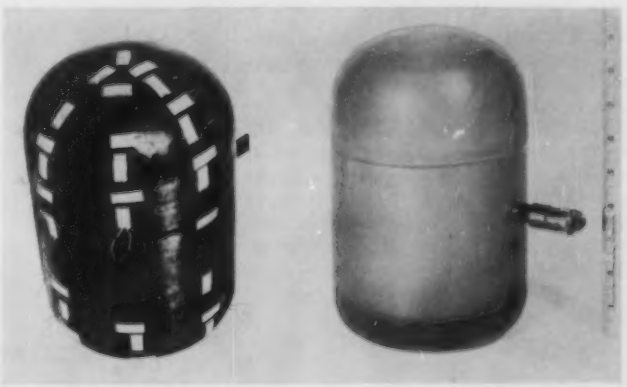
*Research Laboratories, Westinghouse Electric Corp., Pittsburgh, Pa.

The polariscope

The materials mentioned above all become doubly-refracting when subjected to stress. This double-refraction is related to the stress and can be measured by passing polarized light through the stressed plastic and observing the resulting stress pattern of black and white bands, called fringes, if monochromatic light be used, or colored bands for a white light source. The instrument that is used for producing the polarized light and for obtaining the stress pattern is known as a polariscope.

Analytical methods for determining stresses in loaded structures are limited to relatively simple geometries. A duplicate of a proposed vessel, frame, etc., can be made of a photoelastic material and loaded in the manner expected in the proposed structure. The resulting fringe pattern corresponds to the stress distribution that will exist under actual operating conditions. Thus photoelasticity gives accurate information on minutely detailed stress distributions even in complex structures. The technique is also useful in checking the calculations

Fig. 1: Photograph of steel (left) and plastic pressure vessels, identical in size and shape, used to check validity of three-dimensional photoelastic tests. SR-4 wire resistance strain gages have been cemented to steel vessel. Outside diameter—6 in.; wall thickness—½ inch. Steel model tested with pressures up to 10,000 p.s.i.; test pressure for plastic model was 9.7 p.s.i. at a temperature of 150° C.



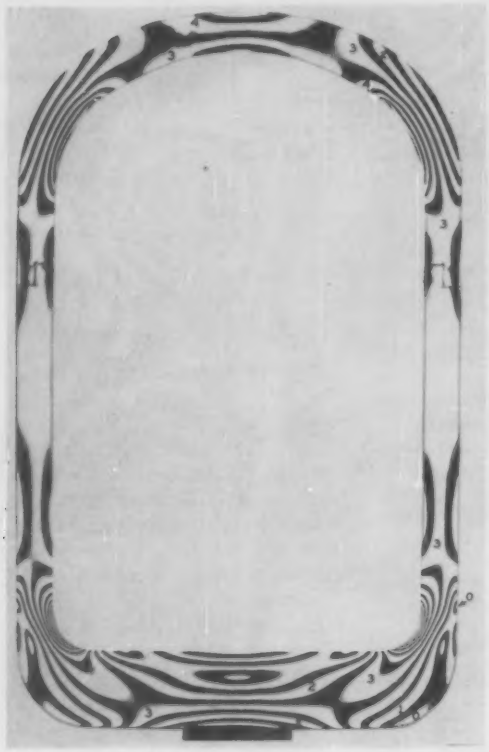


Fig. 2: Stress pattern of meridional slice from epoxy pressure vessel of Fig. 1. Meridional stresses on inner and outer surfaces can be obtained directly from this pattern. Circumferential stresses can be obtained from this same slice by oblique incidence of polarized light. Thickness of slice—0.250 inch. Numerals on stress pattern denote the fringe orders which, when multiplied by the fringe value of 8.52, yield the meridional stress on the outer surface. On the inner surface the internal (gage) pressure must be subtracted from these values

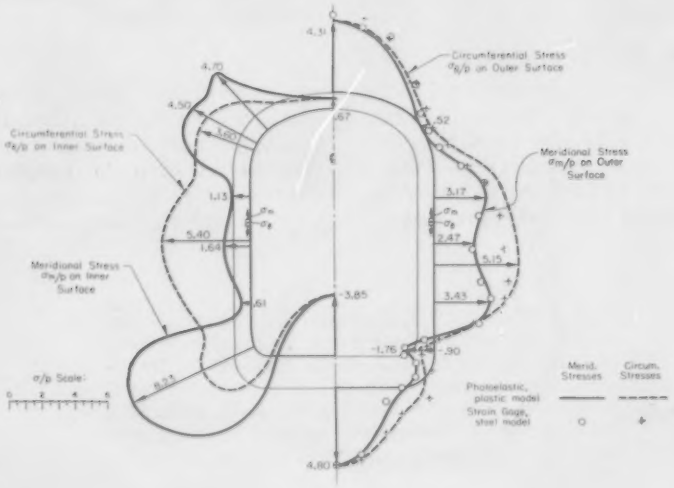

Circumferential Stress σθ/p on Outer Surface
Circumferential Stress σθ/p on Inner Surface
Meridional Stress σm/p on Outer Surface
Meridional Stress σm/p on Inner Surface
σ/p Scale:
Photoelastic, plastic model
Strain Gage, steel model
Merid. Stresses
Circum. Stresses

Fig. 3: Dimensionless stress, σ/p, on surfaces of pressure vessels of Fig. 1, comparing results of strain-gage test on steel vessels with photoelastic test on plastic model. Results are same for left side of vessel as right because of symmetry, so the diagram is divided to show stresses on inside surface of vessel at left, outside surface at right. Stress vectors are drawn perpendicular to the vessel surface at all points, with the surface representing zero on the stress scale. Positive stress value indicates tension, negative indicates compression. Solid and dotted lines represent circumferential and meridional stress as measured photoelastically, circles and crosses indicate corresponding strain-gage readings. Note that for even this simply shaped vessel, stress distribution is very complex

which are arrived at by some unproved analytical or numerical method.

The stress-optic law for two-dimensional stress analysis states that

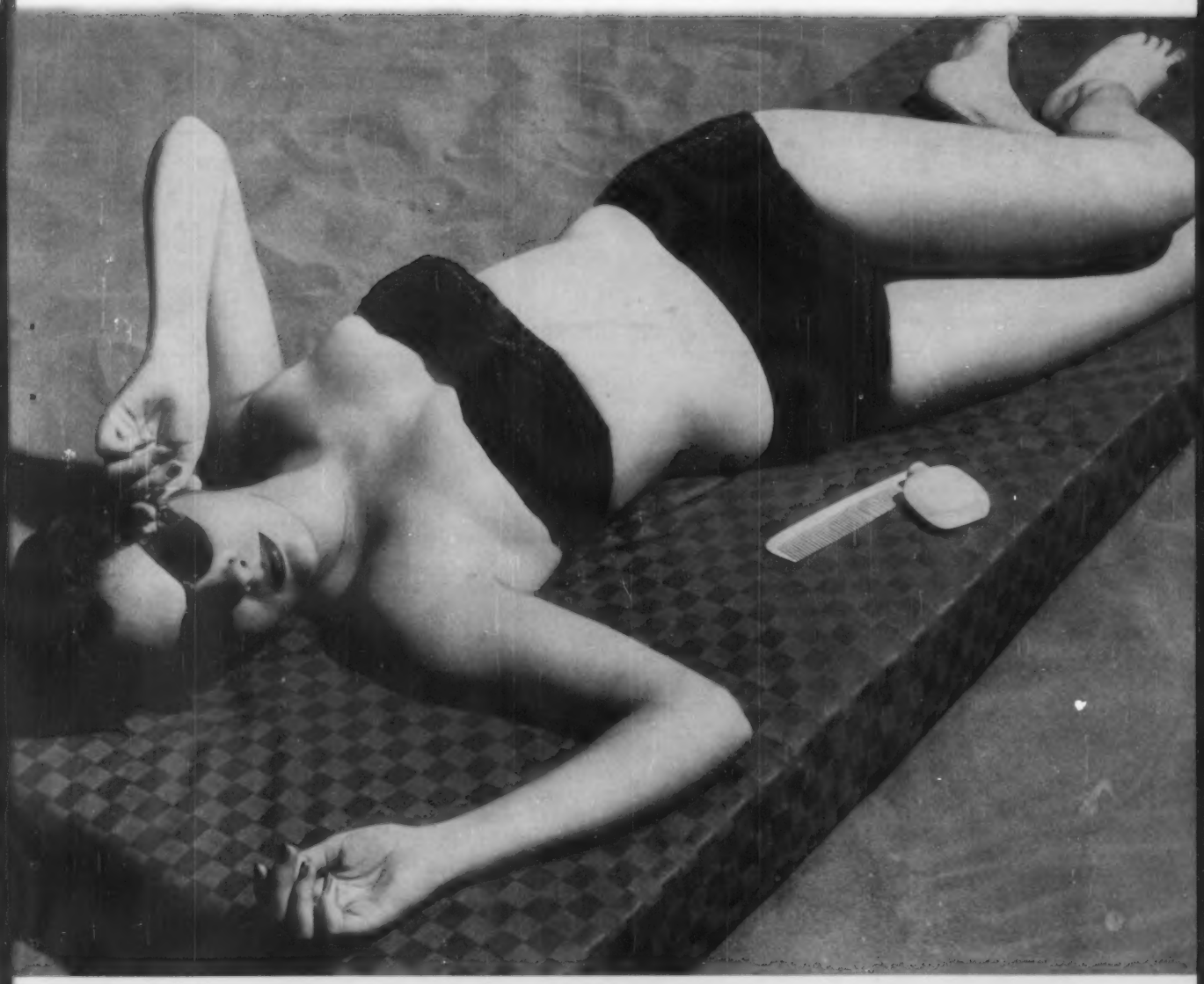
$$\sigma_1 - \sigma_2 = n\, f/t$$

σ_1 and σ_2 denote the principal stresses at a point in the model; n, the fringe order at that point; t, the thickness; and f, the material fringe value, i.e., the stress required to produce one fringe of retardation in a model 1 in. thick. The material fringe value, f, is a constant for a given material.

"Frozen-stress" method

About 1936, Oppel, in Germany, made the first practical "frozen-stress" photoelastic test, using Trolon (an oil-modified polyester) as a model material. In this method the model is heated to a certain temperature, known as the critical temperature, T_{cr}, loaded, and then slowly cooled with the loads acting. At room temperature, the loads can be removed but the strains remain fixed or locked in the model. Careful cutting or slicing will not disturb these strains. It has been shown that these locked-in or "frozen" strains represent an elastic distribution of stress.

The validity of the "frozen-stress" method is established by tests such as the one made on the pressure vessels shown in Fig. 1, p. 151. Both vessels were identical in size and shape, being 6 in. in outside diameter with toroidal top and a flat bottom. The vessel on the left was made of steel and resistance strain gages were used to obtain the strains on the outer surface. The vessel on the right was a plastic model made of an epoxy resin and the stresses on the inner and outer surfaces were obtained photoelastically by the method of stress "freezing" and slicing. Figure 2, above, shows the stress pattern obtained from a meridional slice, while Fig. 3, left, shows the remarkable agreement between the stresses obtained photoelastically and those obtained from the strain gage test which was conducted independently in another laboratory. The greatest discrepancy appears in



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Here's the ideal stabilizer for film, sheeting, plastisols and organosols. Ferro 1212A gives you brighter, clearer transparents and truer whites and colors. It gives you superior heat and light stability and low sulfur-stain potential *at low cost.*

It is easily dispersed with DOP and DOA plasticizers and is completely soluble in mixtures of phosphate or epoxy and DOP plasticizers. In addition, Ferro 1212A is soluble in most phosphate and epoxy plasticizers. It does not increase viscosity build-up of plastisols during storage.

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Fig. 7: Stress pattern of radial slice from head of pres-

the circumferential stresses on the cylindrical portion of the vessel, Fig. 3, and this is probably due to the difference in Poisson's ratio of 0.3 for the metal and about 0.46 for the plastic.

Deformation sensitivity

One of the most important properties which a material must possess to be suitable for three-dimensional stress analysis is a high deformation sensitivity, Q, which is defined as

$$Q = E/f$$

where E is the modulus of elasticity and f the material fringe value at the elevated temperature at which the stress pattern is "frozen." Thus, Q is essentially the number of fringes per unit of deformation. A high deformation sensitivity is required to limit the deformations and deflections in the model to an order of magnitude comparable to that which is to be found in the metal prototype.

Table I, above, gives values of Q for some of the earlier plastics used for three-dimensional photoelasticity and for a typical epoxy resin.

Table I: "Frozen-stress" properties of various plastics used for three-dimensional photoelastic tests

Material	T_{cr}	E	f	Q
	°C.	p.s.i.	p.s.i., in./fr.	fr./in.
Trolon	80	1250	3.00	415
Bakelite 61-893	120	1200	3.30	365
Fosterite[a]	90	1950	3.25	600
Kriston[a]	135	12000	6.25	1925
Epoxy[b]	165	5150	2.30	2235

[a]No longer commercially available.
[b]100 parts by weight Ciba Araldite 6020 and 50 parts phthalic anhydride.

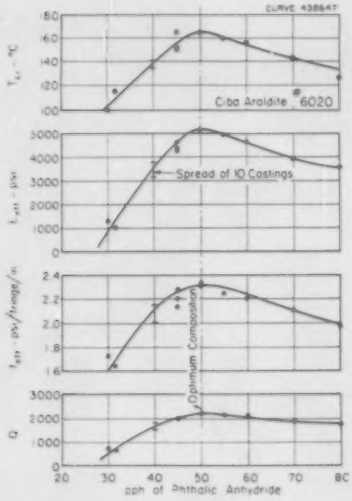


Fig. 4: Variation of photoelastic properties of Araldite No. 6020 with phthalic anhydride content. (pph= parts of curing agent per hundred parts by weight of epoxy)

Epoxy resin

Epoxy resins offer great promise for use in three-dimensional photoelasticity not only because of their high deformation sensitivity, but also because they can very readily be cast in large sizes and meet all of the other requirements of a good photoelastic material. Because of the great bond strength of epoxy adhesives, epoxy parts can be cemented together to simulate welded structures or to facilitate model making. Epoxy resin coatings also

Fig. 5: Epoxy resin model of pressure vessel; clamping ring, bolts, and springs not shown

Fig. 6: Stress pattern of transverse slice through top of head of pressure vessel. Caps in large holes were cemented below this slice, so that large holes in slice are pressure-free. Thickness of slice—0.250 inch

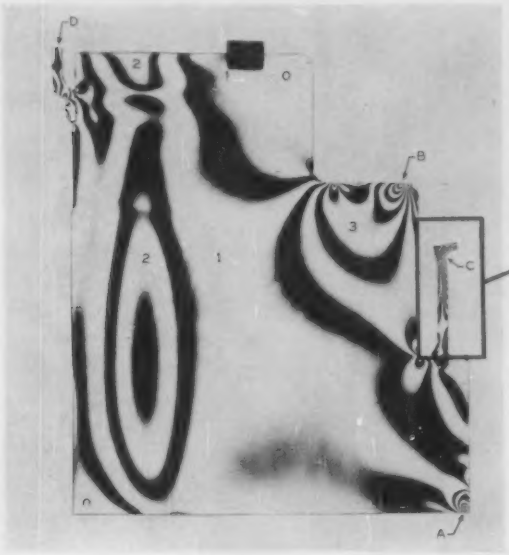


Fig. 7: Stress pattern of radial slice from head of pressure vessel. Slice taken between two No. IV holes (see Fig. 6). Thickness of slice—0.165 inch

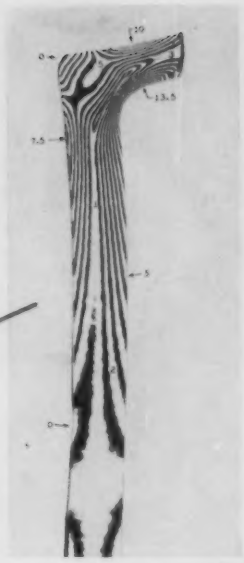


Fig. 8: Enlarged photo of radial slice through seal ring (point C of Fig. 7). Crowding of fringes indicates very high rate of change of stress in direction perpendicular to fringes

show great promise of being suitable for measuring the surface strains on metal parts in both the elastic and the plastic range. The epoxy coating is sprayed or brushed directly on the polished metal surface[1] or on a reflecting undercoating applied to the metal. When polarized light is passed through the coating and reflected back, the photoelastic effect will measure strains on the surface of the metal part due to the applied loads.

There are a large number of epoxy base resins commercially available. These resins can be polymerized by a great number of different hardeners so that a tremendous number of different epoxy materials can be formed. Limiting ourselves to only two of the four or five classes of hardeners—the anhydrides and the amines—we have concluded that the phthalic-anhydride-cured epoxy resins are best suited for three-dimensional photoelastic models. However, the epoxy resin field has not been exhausted.

Anhydride-cured epoxy resins

Table II, above, shows the photoelastic properties of various epoxy resins when polymerized

(*To page* 244)

[1]The coating may also be formed by bonding thin sheets of epoxy resin to the metal surface.

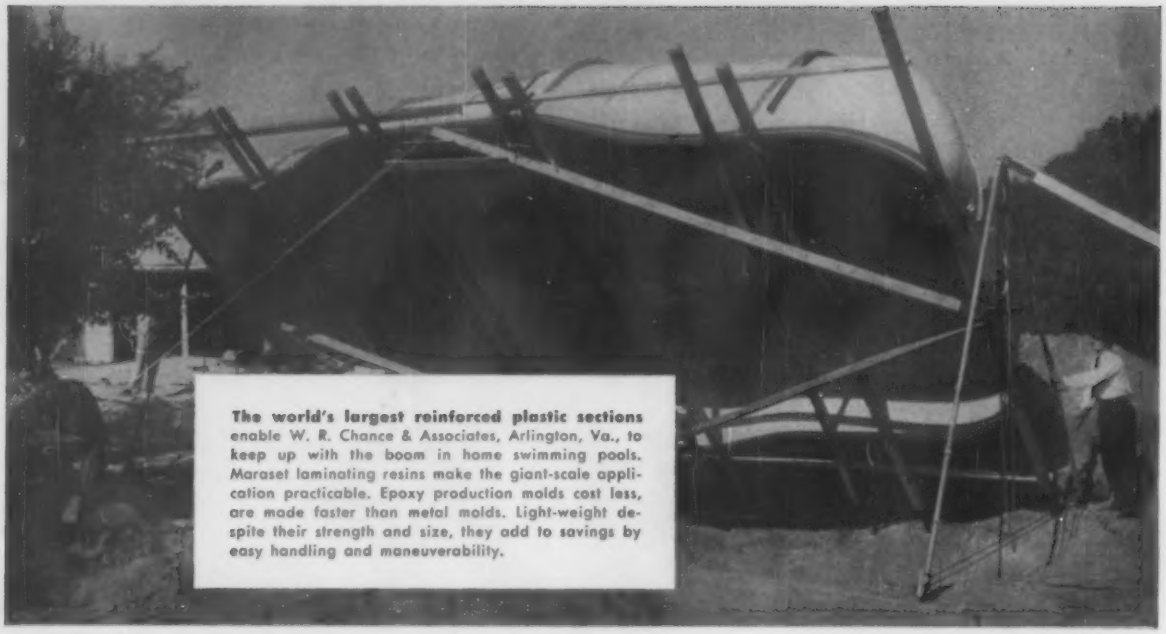
Table II: Photoelastic properties of various epoxy resins cured with 40 p.p.h. of phthalic anhydride

Epoxy	*Viscosity or melting point*	T_{cr} °C.	E p.s.i.	f p.s.i., in./fr.	Q fr./in.
Araldite 502	35 poises	100	2390	1.79	1335
Bakelite ERL 2774	100 poises	133	3600	2.20	1636
Araldite 6020	215 poises	133	3550	2.11	1682
Epon 834	1000 poises	145	2730	1.81	1510
Epiphen 823	2350 poises	147	5100	2.55	2000
Araldite 6060	61° C.	130	2160	1.30	1660
Epon 1001	70° C.	130	2075	1.30	1660
Epi-Rez 520	70° C.	130	2200	1.30	1690

Table III: Properties of Bakelite ERL 2774 epoxy resin when cured with various anhydrides

Anhydride	*p.p.h. of anhydride*	T_{cr} °C.	Q fr./in.	*Exotherm*[a]	*Machineability*	*Transparency*
Phthalic	55	162	2150	1	Fair	Good
HET[b]	65	220	2280	5	Poor	Fair
Nadic[c]	80	140	1400	0	Good	Good
Maleic	40	150	2730	2	Fair	Fair
Dichloromaleic	40	170	2600	4	Fair	Poor
Dodecenyl succinic	80	115	1000	0	Good	Poor

[a]This is a relative scale from 0 to 5, where 0 denotes a very low exothermic reaction and 5 an exceedingly high one which would make the casting of large sizes impossible. The heat generated during curing depends, of course, upon the casting size as well as the curing agent.
[b]Chlorendic anhydride, the anhydride of hexachloroendomethylenetetraphthalic acid.
[c]Allied Chemical & Dye Corp.'s trademarked name for endomethylenetetraphthalic anhydride.



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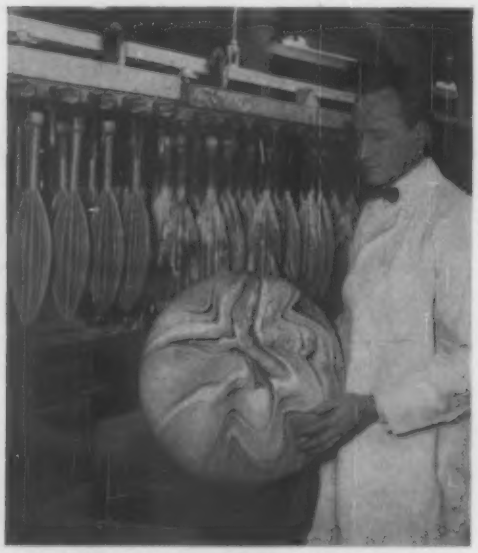

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Plastics Technical Section

Dr. Gordon M. Kline, Technical Editor

Permeability of polyethylene to gases and vapors

By A. W. Myers†, C. E. Rogers†, V. Stannett†, and M. Szwarc†

At the present time about half of all the polyethylene used is in the form of film or coatings on paper or film, or for other packaging applications. In most of these applications, the permeability of polyethylene to gases and vapors is of prime importance. In recent years, various modifications of the original polyethylene have appeared and it is of interest to know how the various modifications have affected the gas and vapor transmission rates. Among the modifications discussed in this report are the effect of crystallinity, of irradiation, of a paper substrate, and finally, the effect of grafting other monomers on to the polyethylene by irradiation in the presence of monomer.

The permeation of gases through intact polymer films is primarily diffusion controlled. When the stationary state is reached, the amount of gas q passing through unit area of film per unit of time satisfies Fick's first law in that

$$q = \frac{D\,S\,(p_1 - p_2)}{l} = \frac{P\,(p_1 - p_2)}{l}$$

where p_1 and p_2 are pressures of the gas on both sides of the barrier, l is the thickness of the film, D is the diffusion constant, S is the solubility coefficient, and P is the permeability constant. P is normally given in units of cubic centimeter of gas at standard temperature and pressure, per second per square centimeter of area for 1 mm. film thickness and 1 cm. of mercury pressure gradient.

The experimental method used was an adaptation of the high vacuum technique described by Barrer(1)[1] and Van Amerongen (2). In this method the film is initially freed from dissolved air and then exposed to pressure p_1 of the desired gas at one surface, while essentially zero pressure is maintained at the other. The increase of pressure with time at the low-pressure side is then followed, and from the steady rate increase the permeability constant can be calculated. Details of the method have recently been published(3,4) and will not be further described at this time.

The various polyethylenes used are described together with their sources in Table I, p. 158.

Permeabilities of various polyethylenes

The permeability constants of a number of plastic films to nitrogen, oxygen, and carbon dioxide are given in Table II, p. 158, and

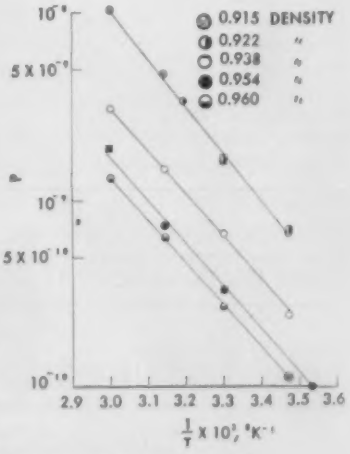

Fig. 1: Effect of density and temperature on nitrogen permeability of polyethylene.

* Reg. U.S. Pat. Off.

Paper presented at the Thirteenth Annual Technical Conference, Society of Plastic Engineers, St. Louis, Missouri, January 16, 1957.

† Chemistry Department, State University College of Forestry at Syracuse University, Syracuse, New York.

[1] Numbers in parentheses link to references at end of article, p. 165.

to water vapor in Table III, below. Polyethylene is seen to be a relatively poor gas barrier but a good water vapor barrier. Normal polyethylenes prepared by the high-pressure process are highly branched, have densities of about 0.92, and are approximately 55% crystalline. The newer low-pressure polyethylenes are more linear, have higher densities, higher crystallinities, and, as shown in Tables II and III, considerably lower permeabilities than the lower-density types.

The effect of density on the permeabilities of polyethylene to nitrogen for a number of temperatures is shown in the form of Arrhenius plots in Fig. 1, p. 157. It can be seen that the familiar relationship

$$P = P_0 \exp(-E_p/RT)$$

is obeyed, where E_p is the energy of activation for the over-all process of permeation. The same was found to be true for the oxygen and carbon dioxide permeabilities and the E_p and P_0 values are given in Table IV.

It can be seen that in every case the more highly branched, lower-density materials have much greater temperature independent factors P_0 and somewhat higher energies of activation E_p. The first effect is reasonable for the more open chain structure resulting from the presence of branches. The higher activation energy is somewhat unexpected, although the series of rubbers—polybutadiene, polyisoprene, and

Table I: Sources of films

Materials	*Source*
Polyethylene (d = 0.915)	The Dow Chemical Co.
" (d = 0.922)	E. I. du Pont de Nemours and Co., Inc.
	Bakelite Co.
" (d = 0.938)	Celanese Corp.
" (d = 0.954)	Celanese Corp.
" (d = 0.960)	Phillips Petroleum Co.
" coated glassine	St. Regis Paper Co.
" " bleached board	St. Regis Paper Co.
" " kraft	St. Regis Paper Co.
" " "	Bakelite Co.
Styrene-polyethylene (graft)	Brookhaven National Lab.
Acrylonitrile-polyethylene (graft)	Brookhaven National Lab.
Vinylpyridine-polyethylene (graft)	Brookhaven National Lab.
Polyethylene, unirradiated	General Electric Co.
Polyethylene, irradiated 10^7 roentgen	General Electric Co.
Polyethylene, irradiated 10^8 roentgen	General Electric Co.

Table II: Permeability of plastics films to gases at 30° C.

	$P \times 10$, (cc./cm.²/sec./mm./cm. Hg)		
Material	N_2	O_2	CO_2
Polyvinylidene chloride	0.0094	0.053	0.29
Polychlorotrifluoroethylene	0.03	0.10	0.72
Polyester (Mylar A)	0.05	0.22	1.53
Pliofilm NO	0.08	0.30	1.7
Polyamide (nylon-6)	0.10	0.38	1.6
Polyvinyl chloride	0.40	1.2	10
Polyethylene (0.960)	2.7	10.6	35.2
Cellulose acetate (plasticized)	2.8	7.8	68
Polystyrene	2.9	11.0	88
Butyl rubber	3.1	13.0	518
Pliofilm P-4	6.2	-	182
Polyethylene (0.922)	19	55	252
Natural rubber	80.8	233	1310
Ethyl cellulose (plasticized)	84	265	2000

Table III: Permeability of plastic films to water vapor at 25° C. (~90% relative humidity)

Material	P (cc./cm.²/mm./sec./cm. Hg)
Polychlorotrifluoroethylene	0.029
Polyvinylidene chloride	0.14
Polyethylene (0.954)	1.3
Pliofilm NO	2.4
Polyethylene (0.922)	8.0
Polyester (Mylar)	13
Polyvinyl chloride	15.6
Polyamide (nylon-6)	70
Polystyrene	120
Polymethyl methacrylate	140
Natural rubber	240
Cellulose acetate (plasticized)	750
Polyvinyl acetate	1000
Ethyl cellulose (plasticized)	1300

Table IV: Permeability[a] to gases of polyethylenes of different densities

	N_2		O_2		CO_2	
Density of polyethylene	P_0	E_p	P_0	E_p	P_0	E_p
0.915	0.47	11.7	-	-	-	-
0.922	0.47	11.7	0.14	10.3	0.015	8.2
0.938	0.023	10.5	0.012	9.4	0.0016	7.4
0.954	0.015	10.6	0.0023	8.8	0.00089	7.4
0.960	0.0072	10.3	-	-	-	-

[a] $P = P_0 \cdot \exp(-E_p/RT)$. Units: E_p in kilocalories/mole; P = cc./cm.²/mm./sec./cm. Hg.

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polydimethyl butadiene—studied by Van Amerongen(2) show a similar trend in the activation energies of permeation. The increase could be due to a somewhat greater cohesive energy in the case of the branched polymer, due to the presence of the methyl groups, or to the larger "zone of activation" involved for the diffusion process(1) through branched polymers.

The permeabilities of polyethylene of three densities to water vapor and methyl bromide vapor are shown in Table V.

There appears to be no simple relationship between permeability and density, or for that matter, between density and crystallinity: Differences in density are due to structural differences in the polymer, particularly in the size and number of branches. The amorphous regions, which determine the density and through which permeation undoubtedly takes place, are therefore somewhat different from polymer to polymer. Furthermore, the crystalline regions may affect the permeability as impermeable fillers and as "cross-linking" agents.

The sorption isotherms also

Table V: Permeability of polyethylenes to water and methyl bromide vapors

Vapor	Temp.	Pressure	$P \times 10^{5}$, cc. STP/mm./cm.²/sec./cm. Hg PE, density 0.922	PE, density 0.938	PE, density 0.954
	°C.	mm. Hg			
Water	25	10.5	10.6	2.45	1.32
		17.3	10.6	2.51	1.52
		23.2	10.6	2.98	1.61
Methyl Bromide	30	166	18.5	4.4	2.02
		521	27.3	5.98	2.58

Table VI: Crystalline-amorphous ratios of polyethylene from density and sorption

Source of data	Amorphous content of polyethylene — Density 0.922	Density 0.938	Density 0.954
	%	%	%
C. A. Sperati, W. A. Franta, and H. W. Starkweather, Jr., J. Am. Chem. Soc. 75, 6127 (1953)	40	32.5	24.5
R. B. Richards, J. Appl. Chem. 1, 370 (1951)	39	29	19
L. E. Nielsen, J. Appl. Physics 25, 1209 (1954)	50	35	20
D. C. Smith, Ind. Eng. Chem. 48, 1161 (1956)	30	18	6
From adjusted sorption curves assuming average value for polyethylene of 0.922 density	40	31	22

Table VII: Permeability of polyethylene and polyethylene-coated papers to nitrogen at 30° C.

Material	Thickness — Polyethylene	Paper	Permeability constant[a] × 10^{10}, cc. STP/cm.²/sec./mm./cm. Hg — Polyethylene exposed to high pressure	Paper exposed to high pressure
	mm.	mm.		
Polyethylene film	0.038	—	2.0 ± 0.1	—
Polyethylene-coated glassine	0.038	0.020	2.6	2.6
Polyethylene-coated bleached board	0.025	0.406	2.5	2.5
Polyethylene-coated kraft paper	0.013	0.0114	1.4	1.6
"	0.025	"	2.3	2.4
"	0.038	"	1.9	2.1
"	0.051	"	1.9	2.0
"	0.064	"	1.7	1.8

[a] Calculated on polyethylene thickness only.

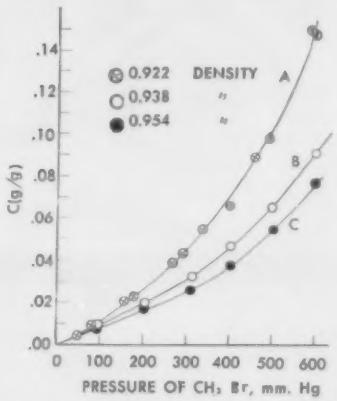

Fig. 2: Sorption isotherms for polyethylenes and methyl bromide at 0° C.

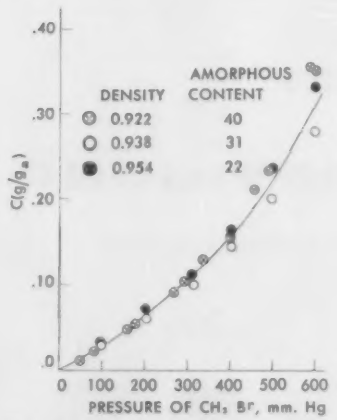

Fig. 3: Sorption isotherms for polyethylenes and methyl bromite at 0° C. (Based on amorphous content only)

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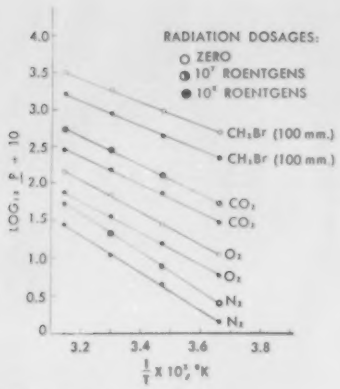


Fig. 4: Permeability versus temperature of irradiated and unirradiated polyethylene

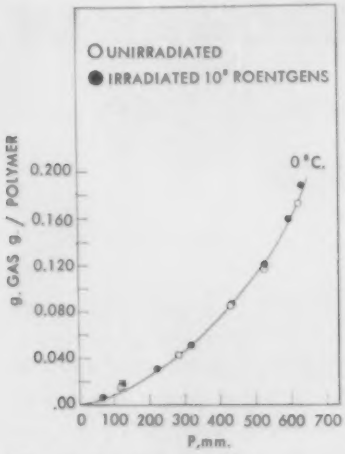


Fig. 5: Sorption of methyl bromide by polyethylene

differ with different density materials; some typical isotherms are shown in Fig. 2, p. 160. One can assume that sorption takes place only in the amorphous regions and adjust the concentration to the amorphous content only. This has been done in Fig. 3, p. 160, where the previous isotherms have been recalculated on the basis of the accepted values for the amorphous content of the three samples. It can be seen that excellent agreement is now found for the three isotherms. This leads also to a value of 1.41 for μ, the Flory-Huggins interaction coefficient for the three polymers, whereas sorptions based on the whole polymer lead to a different μ value for each polymer. This is unlikely since chemically the polymers are largely identical.

A treatment of this kind, therefore, leads to reasonable results and appears justified where swelling of the amorphous regions is not extensive. It can also lead to an approximate calculation of the amorphous-crystalline ratios. The various ratios calculated for the density figures and from the literative relationships are given in Table VI, p. 160.

Table VIII: Permeability of polyethylene and polyethylene-coated papers to water vapor at 30° C.

Material	Thickness: Polyethylene, mm.	Thickness: Paper, mm.	Pressure, mm. Hg	Permeability constant[a] × 10⁷, cc. STP/cm.²/sec./mm./cm. Hg: Polyethylene exposed to high pressure	Permeability constant[a] × 10⁷, cc. STP/cm.²/sec./mm./cm. Hg: Paper exposed to high pressure
Polyethylene	0.038			1.2 ± 0.2	
Coated glassine	0.038	0.020	8	1.05	1.14
			15	1.28	1.29
			20	1.47	1.47
			31[b]	0.89[b]	1.32[b]
			31[b]	0.89[b]	1.32[b]
Coated bleached board	0.025	0.406	11.3	1.4	2.1
			15.3	1.5	2.3
			26	2.6	4.2
Coated kraft paper	0.013	0.011	26	3.6	5.4
	0.025	0.011	27	2.7	4.7
	0.038	0.011	24.5	1.8	3.3
	0.051	0.011	27	1.6	2.6
	0.064	0.011	26.9	1.6	1.9

[a] Calculated on polyethylene thickness only
[b] Cup method

Table IX: Permeability of polyethylene-coated kraft paper to water vapor at 30° C.

Thickness: Polyethylene, mm.	Thickness: Paper, mm.	Pressure, mm. Hg	Permeability constant[a] × 10⁷, cc. STP/cm.²/sec./mm./cm. Hg: Polyethylene exposed to high pressure	Permeability constant[a] × 10⁷, cc. STP/cm.²/sec./mm./cm. Hg: Paper exposed to high pressure
0.013	0.011	26	3.6	5.4
		15.5	2.8	5.1
		10	2.1	4.3
0.025	0.011	27	2.7	4.7
		15.8	2.1	4.2
		9.0	1.6	3.2

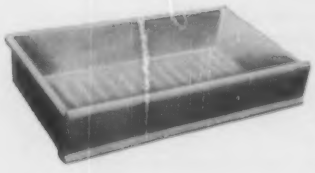
[a] Calculated on polyethylene thickness only

Effect of irradiation

There has been considerable activity in recent years in the field of the irradiation of polyethylene (5). High-energy irradiation has been found to cross-link the polymer, thus raising its heat distortion temperature and changing its tensile strength, elongation, and other mechanical properties. In addition, there has been progress in the sterilization of already packed foods by irradiation through the pack. It is pertinent, then, to ask the effects of such irradiation on the permeability characteristics of polyethylene films.

In Fig. 4, above, are shown plots

CRUCIBLE CSM 2 mold in press at Pro-phy-lac-tic Brush Co., Florence, Mass. The mold, built by Eagle Tool & Machine Co., Hillside, New Jersey, produces vegetable pans for Hotpoint refrigerators.



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of logarithms of the permeability constants versus the reciprocal of absolute temperatures for irradiated and unirradiated polyethylene. It can be seen that there is no effect on the permeability for the samples dosed with 10^7 roentgen but that the 10^8 dosage has resulted in a drop in the permeability constant to about one-half of its original value. The normal sterilization dose is considerably less than 10^8 roentgen, so no deterioration of the vapor barrier will occur during the irradiation.

It is interesting to note that the drop in permeability is due to a decrease in the diffusion constant, the solubility being unchanged by irradiation, as shown in Fig. 5. The decrease in D has been shown to occur in the temperature independent factor D_0 and is probably due to a decrease in the entropy of diffusion brought about by the cross-linking.

Effect of paper substrate

Considerable quantities of polyethylene are used as extruded coatings on paper or glassine rather than as unsupported films. These coated papers are used mainly for packaging and any effect of the paper substrate on the permeability characteristics are of great importance. The permeability of a number of polyethylene-coated papers to nitrogen is given in Table VII, p. 160, where it can be seen that the results are similar to those obtained with pure polyethylene.

The water vapor permeabilities of a similar set of film-paper combinations is given in Table VIII, p. 162. Some of the samples show a pronounced two-sided effect with greater permeability resulting when the paper side is exposed to the high humidity. This effect is seen to disappear with the thicker coatings and is believed to be due to a "wicking" action of paper fibers penetrating part way through the sheet. Such wicks would be most effective when swollen by exposure to the high humidity side.

Further support for this viewpoint is found in the fact that the permeability constant is dependent on relative humidity for the two-sided films as shown in the data summarized in Table IX, p. 162. Normally, the permeability constant for water vapor through polyethylene is essentially independent of relative humidity and the dependence shown in Table IX is probably associated with the swelling and transport action of the paper fiber wicks. When dry nitrogen is used, as in Table VII, the wicks are dry and the polyethylene relaxes tightly about the relatively impermeable fibers and no two-sidedness is observed.

The gas permeabilities of polyethylene-coated papers are not always similar to those of unsupported films, as the values given in Table X, left, demonstrate. Samples with similarly low permeabilities were found to have water vapor transmission rates similar to those of unsupported films, although the humid nitrogen permeabilities were lower. These low permeation rates were only found with films that were very difficult to detach from the paper substrate and varied from sample to sample of the same batch of coated paper. The detached films were found to have normal permeabilities. The re-

Table X: Permeability of polyethylene and polyethylene-coated kraft paper to nitrogen

Material	*Temp.*	*Permeability constant*[a] $\times 10^9$, *cc. STP/cm.²/sec./mm./cm. Hg*
	°C.	
Polyethylene	0	0.20
	30	1.8
	60	9.5
Polyethylene (separated from kraft paper)	30	1.2
Polyethylene-coated kraft paper		
Sample I	30	1.2
	60	5.1
Sample II	0	0.051
	30	0.43
	60	2.3
Sample III	30	0.91
Sample IV	30	0.76
Sample V	30	0.70

[a] Calculated on polyethylene thickness only

Table XI: Permeability of styrene-polyethylene graft copolymers

Styrene graft	*Nitrogen at 30° C.*			*Carbon dioxide at 30° C.*		
	$P \times 10^9$	P_o	E_p	$P \times 10^9$	P_o	E_p
%						
0	2.00	0.66	11.8	28.0	0.081	9.0
4.8	1.50	0.28	11.5	22.5	0.032	8.6
13.4	1.35	0.19	11.3	18.0	0.019	8.35
20.9	0.92	0.03	10.4	14.9	0.016	8.4
34.4	0.97	0.008	9.6	15.8	0.0011	6.7
41.3	1.05	0.006	9.4	20.2	0.0004	6.0
Polystyrene	0.29	1.6×10^{-4}	5.2	8.8	1.7×10^{-7}	1.8

Table XII: Permeability of acrylonitrile-polyethylene graft polymers

Acrylonitrile graft	Nitrogen at 30° C.			Carbon dioxide at 30° C.		
	$P \times 10^6$	P_o	E_p	$P \times 10^6$	P_o	E_p
%						
0	2.00	0.66	11.8	28.0	0.081	9.0
1.8	1.73	0.28	11.4	25.4	0.036	8.6
4.1	1.57	0.39	11.7	19.7	0.042	8.8
9.3	1.26	0.24	11.5	17.1	0.032	8.7
20.8	1.06	0.43	12.0	13.6	0.041	9.0
31.3	0.71	0.25	11.9	9.7	0.026	8.9

Table XIII: Permeability of graft polyethylene copolymers to methyl bromide at 0° C.

Methyl bromide pressure	p/p_s	Permeability constant $\times 10^6$	
		20.9% styrene graft	20.8% acrylonitrile graft
mm.			
100	0.15	1.7	1.9
305	0.46	6.0	4.7
444	0.67	21.0	10.0
569	0.86	62.0	27.0
625	0.95	110	47.0

Table XIV: Permeability of polyethylene-vinylpyridine graft copolymers to nitrogen

Temp.	Permeability constant $\times 10^6$		
	Polyethylene	28.4% vinyl-pyridine graft	60.2% vinyl-pyridine graft
°C.			
30	2.0	0.60	0.15
60	10.9	3.50	0.81
75	23.2	7.26	1.92

sults are believed to be due to the fact that the hot polyethylene is pressed deep into the interstices of the paper. This could result in an increase in the effective thickness l of the polyethylene and a reduction in the effective surface area A resulting in an over-all decrease in the gas transmission q since

$$q = \underline{P}\,\Delta p\,\frac{A}{l}$$

This effect would not occur with water vapor since the paper fibers would be "permeable" to water inasmuch as there would be capillary action along the fibers.

Such an explanation is difficult to prove, although it has been found that the apparent thickness of the coating as measured by caliper, compared with the thickness calculated from the area and density, is greater for the lower permeability combinations. A detailed report of this work will be made elsewhere (6).

Graft polymers' permeability

A further way of modifying polyethylene film was achieved when it was found possible to graft other polymer branches to the main polyethylene chains by irradiating the film in the presence of monomer. A number of such graft copolymer films were made available to us by the Brookhaven National Laboratory for gas permeability measurements. The results of such measurements for a series of styrene-polyethylene graft films are shown in summary form in Table XI, opposite, and for an acrylonitrile-polyethylene series in Table XII, above. In each case, the irradiation dose was not itself enough to affect the permeability constant of the polyethylene.

It can be seen that no great changes in the permeability to gases were brought about by grafting either styrene or acrylonitrile to the polyethylene, the greatest change being a reduction in the permeability to about one-third of its original value. However, the permeability to organic vapors is superior with the acrylonitrile grafts and inferior with the styrene grafts, as would be anticipated from solubility considerations. These effects are felt mainly at higher vapor pressures when swelling becomes appreciable (see Table XIII).

More recent work with vinylpyridine grafted onto polyethylene shows a considerably greater effect on the permeability constants and some preliminary results are given in Table XIV.

The discussion on the various modifications of polyethylene film has necessarily been brief, and a fuller treatment of the modifications will be published later.

We would like to thank the various companies and agencies that donated the samples, and the Quartermaster Corps and T.A.P.P.I., under whose sponsorship the work was carried out.

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Thermal conductivity of a plastic honeycomb sandwich

*By Melvin Mark**

Radome materials commonly used include the plastic sandwich type structure composed of two faces or skins of dense material separated by and bonded to a honeycomb core (Fig. 1). The question often arises of how to calculate the elastic and thermal properties of such a section. A method for calculating the elastic beam properties is discussed in a previous publication (1).[1] A simple method for estimating the thermal conductivity value is presented in the following discussion. Comparison with experimental data is then made.

An expression for the equivalent thermal conductivity k of a sandwich honeycomb such as shown in Fig. 1 can be written as

$$\frac{2t}{k} = \frac{C}{2t} = \frac{2t}{k_s} + \frac{1}{C} \qquad \text{Eq. 1}$$

where k_s is the thermal conductivity of the skin material, C is the conductance associated with the core, and the other symbols are as defined in Fig. 1. If C in equation 1 is considered to be made up of conduction through the solid part of the honeycomb and convection through the air cell of the honeycomb, the following can be written:

$$C = \frac{xh}{2} + (1 - x)\frac{k_c}{C} \qquad \text{Eq. 2}$$

where h is the film coefficient for the honeycomb air cell, k_c is the thermal conductivity of the core material, and x is that fraction of the core area that is air.

The first term in equation 2 represents the heat transfer through the air cell. When such an air space forms part of a wall construction, an additional resistance to heat flow is introduced at each added surface. Because of the difference in temperature on the two sides of the air space, some degree of air movement is set up within the space unless the space is unusually narrow. Heat is transferred across the space by convection currents and by radiation. The resistance of the air space is, therefore, approximately the sum of the two individual surface resistances or 2/h. Consequently, the term xh/2 appears in equation 2 for that fraction of core area that is air.

The value to use for h in equation 2 could be expected to lie between two limiting values. The lower limit would be the h value equivalent to the conductivity of an air space equal to the core thickness. The upper limit would be the equivalent value obtained for an air space infinite in two dimensions, but of thickness equal to the core thickness (2). The true value for h would be greater than the value for the lower limit as air movement is present, yet less than the upper limit since the air space is of finite dimensions. Consequently, an average value of the two limits appears reasonable for an approximate answer.

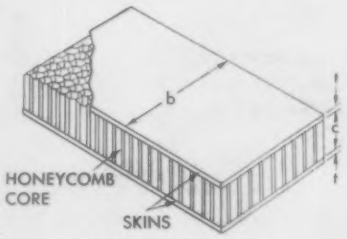

Fig. 1: Honeycomb sandwich

An experimental determination was made, using standard apparatus at the Massachusetts Institute of Technology, of the thermal conductivity for two honeycomb sandwich samples. The samples had 0.034-in.-thick skins made of combinations of 181 and 112 glass fabric with Garan finish, impregnated with polyester resin (BRS 142). Sample *A* had a 4-lb./cu. ft. nylon phenolic honeycomb core 0.309 in. thick, sample *B* a 6-lb./cu. ft. CTL (glass fabric) phenolic honeycomb core 0.311 in. thick. Both cores had ¼-in. cell size honeycomb and were bonded to the skins with epoxy resin. The thermal conductivity of the skin material k_s was 2 B.t.u./hr.-sq.ft.-°F./in.; the value for the core material k_c was 1.5 B.t.u./hr.-sq.ft.-°F./in. The cross-sectional core area for sample *A* was 94.5% air, 5.5% solid material; for sample *B*, 93.5% air, 6.5% solid. Applying equations 1 and 2, the values shown in Table I are obtained; the experimentally measured values are given also.

Since the thermal conductivity values used for the skin material

(*To page 247*)

Table I: Experimental thermal conductivity data

Sample	*Temperature*	*Thermal conductivity, k (B.t.u./hr.-sq. ft.-°F./in.)*	
		Experimental	*Calculated*
	°F.		
A	61	0.463	0.45
A	114	0.486	0.50
A	150	0.509	0.53
B	63	0.493	0.46
B	107	0.512	0.51
B	140	0.538	0.54

*Consulting Engineer, Cambridge, Mass.
[1]Numbers in parentheses link to references at end of article, p. 247.

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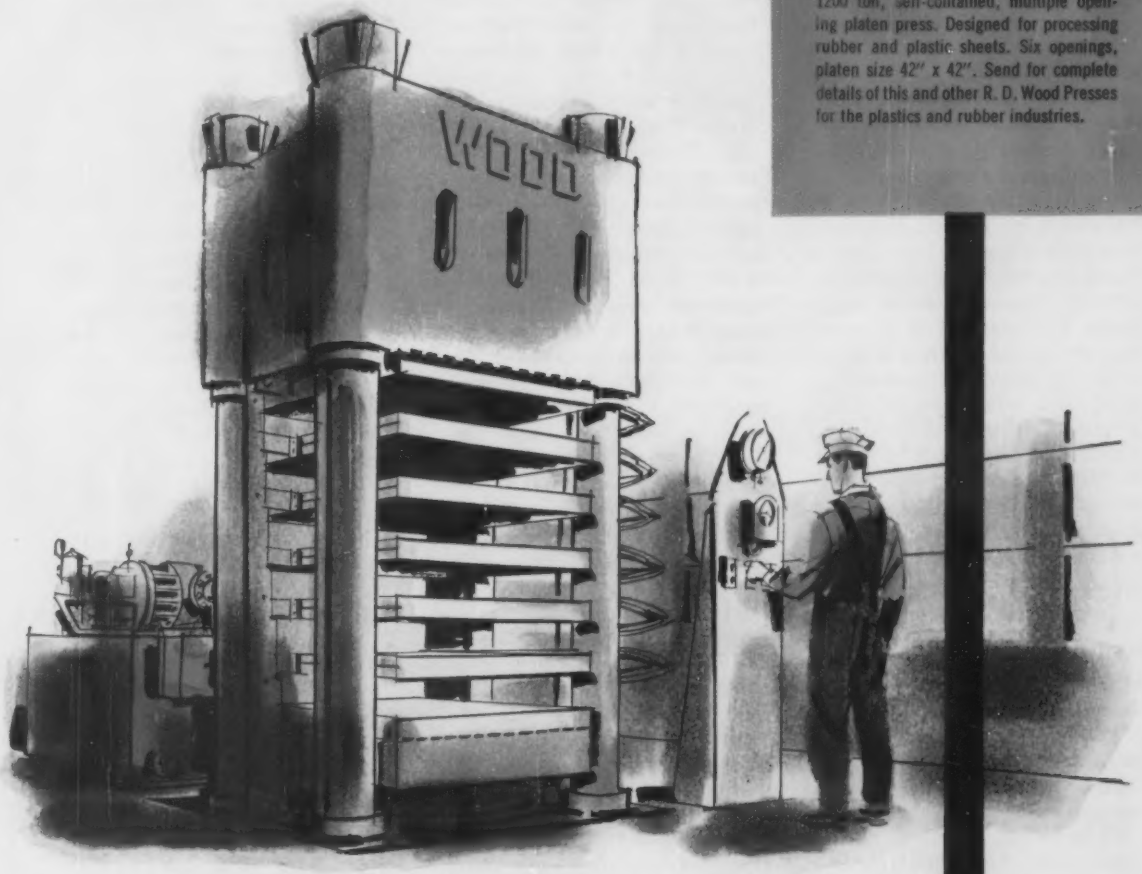

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Stabilization of plastics

*By George H. Taft**

During the last year developments in stabilization have been limited to the improvement of well established techniques. Although such an approach has not led to major improvements, both the stabilizer manufacturer and the user have obtained a more complete understanding of their problems.

Because means of preventing degradation are not known, stabilization is limited to control of the degradation process. The past few years have seen universal adoption of multiple stabilization because of a better realization of the many facets of the problem.

Studies of the effects of ionizing radiations on organic materials, especially polymers, have been of major interest. Such research has already produced a clearer qualitative understanding of degradation and some progress is being made on obtaining quantitative data. Such information is necessary for a major break-through in product stability, either by the introduction of more stable materials or by establishment of means of actually preventing degradation. An excellent review of radiation effects was published by Collinson and Swallow (1).[1]

A serious defect in the stabilizer development program is lack of effective methods of accelerating aging and of recording results.

Parkyn (2) has published a tabulation of two years' observations on glass-reinforced resin structures. His observations are:

1) Heat has a much greater effect than ultra-violet light.

2) Ultra-violet absorbers decrease ultra-violet discoloration but, at the same time, increase heat discoloration.

3) Under heat, the glass-polyester laminate yellows at a higher rate than the unfilled resin.

4) High - resin - content laminates yellow more slowly than those of low resin content.

5) Changes in fiber finish and type of binder show no differences in discoloration.

6) Rate of discoloration increases if cellophane or other material is left on the surface.

7) Yellowing is essentially at the surface. When polished off, further yellowing does not occur.

8) Cobalt absence increases yellowing rate; high accelerator ratios decrease it.

9) Rate of yellowing is increased if all inhibitor is omitted.

10) Eliminating all aromatics from the resin does not eliminate discoloration.

Foster and Spohn (3) found that heating polyethylene at 100 to 120° C. for 48 hr. caused an increase in crystallinity and a decrease in apparent elongation, improved abrasion resistance, lowered heat distortion at a given temperature, and produced no signs of oxidative degradation. Methods of reporting such observations on a quantitative basis must be developed for rapid progress in stabilization techniques.

Kiyota (4) has reported a method of determining hydrogen chloride evolution from polyvinyl chloride by burial during heating in calcium carbonate and determination of chlorides. Doyle and Duckwald (5) have developed a method of following changes in glass laminates using low-frequency vibrations. Hamilton et al. (6), working with nylon, tried to find an accelerated testing procedure to correlate with actual aging. X-ray radiations showed some promise while ion bombardment did not.

Degradation processes

Degradation of commercial plastic products can lead to changes in color, weight, hardness, continuity, shape, internal stresses, and odor. Due to the high standards now demanded by the consumer, the compounder is concerned primarily with the first stages of degradation.

The process of degradation is undoubtedly started by the degradation of the polymer, although it is doubtful that polymer degradation proceeds very far. The observed effects of aging probably result mainly from further reaction of the products of initial decomposition, in some cases with external agents.

Organic materials added in the form of plasticizers, softeners, and lubricants are a major source of change, not because of direct degradation but as the result of side reactions, usually with products of polymer degradation. Esters can saponify to produce volatile or incompatible products while some compounds, such as the aromatic phosphate esters, may be subject to direct color change in the presence of strong bases or metal oxides. The materials and techniques available today do not make plasticizer choice an insurmountable problem.

Color pigments and fillers of proper stability are now available for practically all polymers and uses. The major problems here involve color stability during processing.

Degradation rates are known only in a qualitative way. Considerable progress is being made in obtaining quantitative information.

Present data indicate polymer degradation can occur by oxidation, degradation of polymer side chains, degradation of polymer main chains, cross-linking, and evolution of molecules by dehydrogenation or dehydrohalogenation. Studies with ionizing radiations have done much to clarify the conditions under which these various processes occur.

In vinyl polymers under ionizing radiation, cross-linking can

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[1]Numbers in parentheses link to references at end of article, p. 176.

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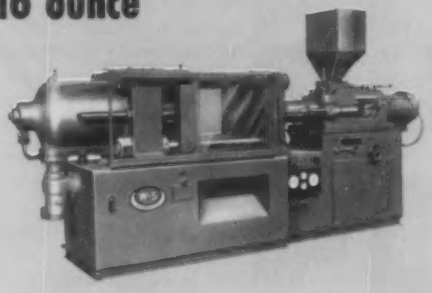

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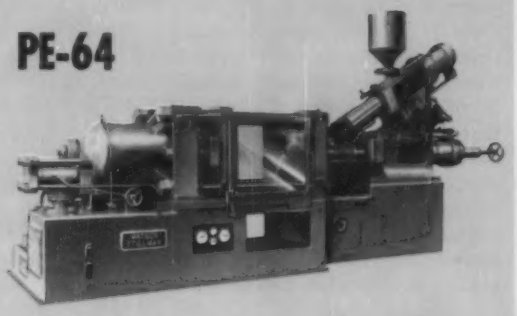

Maximum ounces per shot (Styrene).....90
Plasticizing capacity per hour.....285 lbs.
Maximum die sizes.....27" x 45" x 25" x 40½"
(Ask for bulletin 624)

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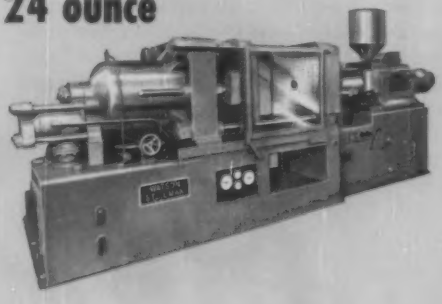

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occur only when the polymer chain contains at least one hydrogen alpha to the methylene group. Main chain degradation occurs only when the polymer is of the form $[-CH_2C(X)(CH_n)-]_n$. Rearrangements in the molecule during aging can complicate this method of analysis and such agents as oxygen can interfere with predicted reactions.

Using ultrasonic radiations in solutions of polystyrene and of polymethyl methacrylate, Henglein (7) found macromolecular sized free radicals were formed. Twenty percent of those formed in the polystyrene and 40% of those formed in polymethyl methacrylate were deactivated by combination, partly to form block polymers. Hart (8) was able to explain volatile losses during thermal degradation of polymethyl methacrylate by assuming a free radical chain reaction using an internal chain transfer process.

Jones et al. (9) report that polymethylstyrene has a long chain transfer or "zip" length and shows more depolymerization during aging than does polystyrene.

Kargin and Shtedling (10) found that ultra-violet exposure of polyvinyl chloride produced reactive groups in an inhibited state at room temperature. When temperatures are raised, these reactive groups or free radicals are deactivated by reaction with low-molecular-weight impurities or by recombination with polymer chains.

Evolution of hydrogen chloride is the first step in polyvinyl chloride degradation. Yamada (11) found the induction period for hydrogen chloride release was cumulative, making impossible the lengthening of that period by the use of intermittent heating. Ultra-violet light has a large effect on the induction period while oxygen has but little.

Scott (12) has found that labile chlorine can be removed from polychloroprene by heating in the presence of a strong base to give products of increased stability.

Wilson (13) reports that the oxygen uptake of polyethylene goes through an induction period, a constant rate stage, and a decreasing reaction rate stage. The activation energy of the induction period is 25 kcal./mol and of the constant rate period 35 kcal./mol. He was able to greatly increase the induction period by using amino or phenolic antioxidants. Aging polyethylene in molecular oxygen, ozone-enriched oxygen, and fuming nitric acid, Beachell et al. (14) found the oxygen oxidation to be a second order reaction. With oxygen- or ozone-enriched oxygen the activation energy was 8 to 9 kcal./mol; in fuming nitric acid, 35.6 kcal./mol.

In studying the oxidation of polysiloxanes, Andrianov and Sokolov (15) found that both the Si-C and the Si-O bonds ruptured in the linear chain structures but only the Si-C in spatial structures.

Delzenne and Smeto (16) found homolytic degradation in polyacetaldehydes due to peroxides present from the polymerization. The degradation was first order with respect to the hydroperoxide content.

Polyvinyl alcohol at 195° F. in nitrogen shows no changes in color, double bonds, and carboxyl groups. In oxygen, however, the number of double bonds and carboxy groups increase, hot-water-insoluble materials forming (17).

Wall and Michaelsen (18) found tetrafluoroethylene polymers depolymerize thermally below 480° C. by a zero order law. This degradation is strongly catalyzed by oxygen, nitrous oxide, and sulfur dioxide; not altered by nitrogen or trifluoromethylbenzene; and inhibited initially by hydrogen, chlorine, and methylbenzene. Energy of activation of depolymerization was 100 kcal./mol with chlorine and 64 kcal./mol with methylbenzene.

Air aging films of polyethyl acrylate, polybutyl acrylate, and polyvinyl acetate at 130 to 150° F. for 14 days, Eich (19) found the color number and specific viscosity to be related up to the time that the minimum specific viscosity was reached. He assigned the changes to depolymerization and repolymerization.

Factors in stabilization

In practical application of stabilization, the factors to be considered are: 1) type of aging stress to be encountered, 2) type of stability required, and 3) polymers and other ingredients to be used.

To accomplish these ends, the compounder must control: 1) oxidation, 2) polymer degradation, and 3) reaction of degradation products to give undesirable products.

Control is accomplished by: 1) absorption of incident radiations, 2) prevention of oxidation, 3) removal of catalytic products of breakdown, and 4) neutralization of active centers and free radicals.

The materials added for stability can be classed as: 1) screening agents, 2) antioxidants, 3) acid neutralizers or absorbers, and 4) sources of free radicals.

The medium in which all stabilizing reactions occur is nonaqueous. Ability to visualize reactions in such medium is limited and is one of the difficulties the compounder faces. Because the stabilizing reactions must occur rapidly to be effective, the plasticizer present is usually of prime importance. Its control is due to not only its solvating power for all ingredients, but also to its dielectric character and consequent effect on reaction rates and equilibria.

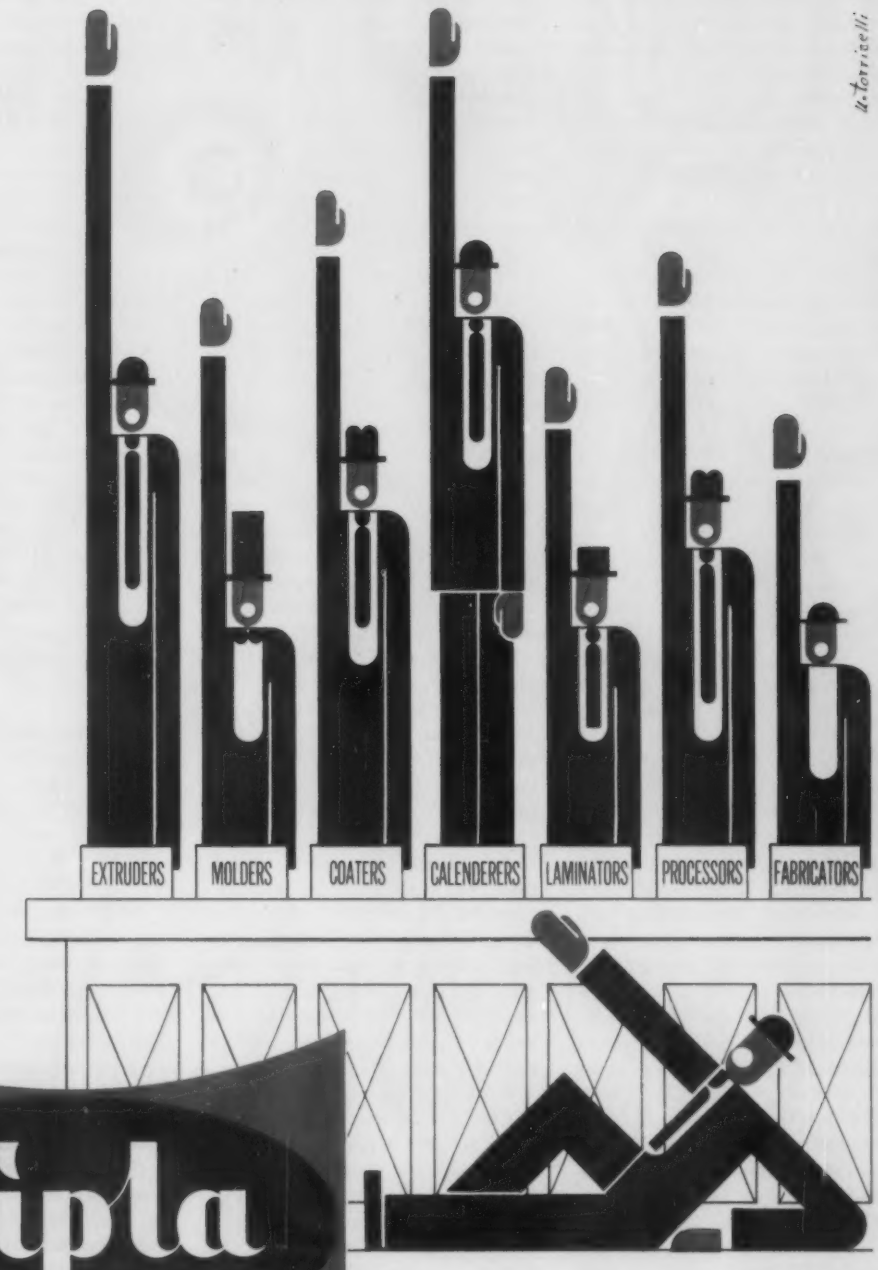
Stabilizing agents

The use of screening agents is somewhat limited by the materials available. One of the major problems is the prevention of discoloration of the screening agent. The inclusion of large amounts of resonating structures is the usual basis of the screening action, although such materials as carbon act as direct shields. Salicylic acid and its derivatives continue to be of prime importance here.

Snyder et al. (20) recommend three screening lacquers for application to polystyrene surfaces. Two of these are mechanical screens incorporating carbon black and aluminum pigments, while the third is a transparent film containing an organic screening agent.

Sudekum (21) uses large amounts of flocculated metals in chlorosulfonated polymers, undoubtedly partly for their screening effect.

In using screening materials,



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the fact that they act by conversion of radiant energy into some other form, usually heat, must be allowed for. Recent patents on screening agents usually specify the presence of heat-stabilizing materials also.

Antioxidants have long attracted attention, partly because of the lack of universally satisfactory materials. Unlike the curing rubbers, where an antioxidant can affect aging by regulating the type of cure obtained as well as by its presence in the finished product, most plastics materials can use only the latter effect.

Antioxidants prevent the oxidation of both the original polymer and active centers formed by degradation. The major problem is finding effective antioxidants that do not bleed and that show minimum color change during processing and aging.

Chamberlain, DeLap, and Stacy (22) show that ethyl cellulose weathers well when only an antioxidant is present if light is excluded.

As antioxidants, phenols still attract the most attention. Kennerly and Hook (23) suggest a trisubstituted monohydroxy phenol with a metallic salt of a dithiophosphoric acid ester as a general antioxidant for organic materials. Young and Banes (24) have patented a series of aralkylated alkoxy phenols. Du Pont (25) has covered the use of nitrogenous or phenolic materials in formaldehyde polymers. Lowe (26) finds the use of glycidyl ethers of phenols helpful in phosphate-plasticized cellulose acetate. Huck (27) and Furukawa and Kimura (28) have patented the use of certain phenols. Fischer and Vanderbilt (29) have published data on bisphenol-A in plasticized polyvinyl chloride.

DeCroes and Tamblyn (30) use propyl gallate with cellulose acetate butyrate, while Robertson (31) uses a mixture of *tert*-butyl hydroxyanisole, propyl gallate, citric acid, and ascorbic acid in wax and food compositions.

Groff and Dearing (32) use a mixture of an alkoxy phenol with a metal salt of dithiocarbamic acid in styrene-modified synthetic rubber. Vincent (33) uses 2-mercaptoarylene-imidazole in polyethylene for resistance to strong sunlight.

DePree and Hill (34) use a guanylguanidine in oxygen-sensitive materials; amines are mentioned by Wood and Wilkinson (35) and by Formo et al. (36).

Jones et al. (9) find 1,4-naphthoquinone as effective as a vacuum in preventing depolymerization of alpha-methylstyrene polymer. Iodosobenzene showed some effect.

Rumberger (37) uses a diaryl ketone in petroleum wax.

The phosphites can function as both an antioxidant and as a sequestering agent. Organo-phosphites are mentioned by Lipke and Montgomery (38) for polyvinyl chloride, Hunter (39) for butadiene-styrene polymers, and by Linville (40) in polysiloxanes.

Stanton and Ehlers have patented a series of stabilizers for acrylonitrile including formals, acetals, glycol ethers, carbamates, alkylsulfones, aminonitriles, carboxynitriles, and thioglycolates. (41,42,43,44,45,46,47). Other acrylonitrile polymer stabilizers are alpha-bromobutyric acid (48) and some carboxylic acids added during the polymerization (49).

Chlorine-containing polymers

Control of the catalytic products of breakdown is, of course, of most importance in chlorine-containing polymers. Hercules' introduction of the Penton resins is an attempt to control this problem by use of proper polymer design. Scott (12) attempts to remove all labile chlorine before polymer use.

Production of hydrogen chloride probably can not be prevented. Lead silicates show some lengthening of the induction period, probably due to hydrogen chloride adsorption rather than inhibition of the degradation reaction.

Usual practice is to remove the hydrogen chloride by neutralization, usually by use of a metal salt or an organo-metallic compound. Most development work is now aimed at improving the agents available and at the inclusion of materials that also produce free radicals.

One of the continuing developments is in sulfur- and nitrogen-containing stabilizers for the vinyls. Together with tin, these materials must be used carefully due to the extreme effects that they can have through acceleration of breakdown rates. Experience and recent developments have improved the use of these materials. Small amounts of zinc are of definite interest today in the production of clear films and sheeting.

Of particular interest are the stabilizers containing tin attached to sulfur-containing radicals, usually through a tin-to-sulfur bond. These include tin salts of thioether acids, tin mercaptides, organo-tin sulfides, tin salts of mercapto-substituted acids, tin xanthates, and reaction products of organo-tins with mercapto alcohols. Apparently these materials can function as acid absorber, free radical producer, and antioxidant.

Interest in other tin compounds continues. Recent patents cover reaction products based on esters, polymeric materials, and phosphates.

Sudekum (21) uses flocculated metals in the chlorosulfonated polymers. Finholt (50) uses chromic oxide to improve the flex life at elevated temperatures of chlorofluoro polymers.

Other stabilizers

Stabilizers containing metals have been suggested for many polymers other than the chlorides. Talcott (51) uses an iron salt with organo-silicon polymers, while Rossiter and Currie (52) use a series of tin compounds.

In acrylonitrile, Slocumbe uses metal salts of vinylsulfonic acid (53) and of cinnamic acid (54).

Gabler and Kummel (55) add a chromium salt to the polymerizer to produce a chromium-containing polyamide of improved stability. Dannenberg (56) adds an alkaline earth metal salt of a carboxylic acid to prevent gas checking and frosting in air-dried ester films.

A series of patents cover stabilization of polysulfones by amides, thiols, and thiophosphate esters (57,58,59,60,61,62).

Symonds (63) and Barker et al. (64) cover the use of alkyl amides in polyethylene and Strain (65)

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uses a dicyanamide with polycarboamides.

The epoxies are now used in most cases primarily for their stabilizing action. They are most effective when used as boosters for metallic neutralizers, particularly with the barium-cadmium combinations which are becoming standard. Moorshead (66) has reported that with the emulsion resins, the epoxidized oils are as effective as the resin type epoxies and are much better with the suspension polymers. Lovell (67) uses epoxy compounds in cellulose esters and ethers and Meis, Scheib, and Decker (68) in the amino resins.

Neutralization of active centers is now accomplished without the addition of specific agents for that use only. Many of the tin compounds undoubtedly depend for part of their action on the ability to release free radicals. The unsaturated materials such as oxycresolcamphene (69), 4,4'-bis(3,4-methylenedioxybenzamido) stilbene-2,2'-disulfonic acid (70), a hydroxybenzophenone (71), and salicylalazine (72) may be of this type.

The beneficial effects of hydroxy compounds are being recognized. Both Lally and O'Hara (73) and Jankens (74) use stabilizing mixtures containing hydroxyl groupings. Clark (75) uses aliphatic alcohols as stabilizers for organosilicons.

The use of small amounts of aromatic phosphate esters for increasing light resistance is becoming more prevalent. This may be more the result of solvating and screening actions than of true stabilization.

The use of chelating agents continues. These materials probably not only remove traces of catalytic metals, but may also control the amount of metals released from the stabilizer salts present in the reaction medium, important with the tin- and zinc-containing materials. Bersworth (76) has patented a non-toxic stabilizer containing metals chelated by a polyamino-polyacetic acid. The maleates may owe some of their effects to chelating actions as well as additions at the double bond.

A patent by Mack and Parker (77) may mark the start of considerable interest in some of the rarer metals. New metal technologies will undoubtedly make some of these materials, such as zirconium, more available at practical price levels.

For polyvinyl chloride, the standard stabilizer systems are largely based on barium-cadmium salts. Tin compounds are used where clears are required, although the use of traces of zinc with barium-cadmium has become of importance.

Stabilizer manufacturers have, generally, tried to offer standard mixtures to the user. This practice usually requires some modification to meet each consumer's particular requirements. Consequently, supplying of stabilizers is still largely on a specialty basis.

For electrical use, lead compounds are still the favored stabilizers.

Non-toxic stabilizers are a serious problem. Lack of approved systems is definitely restricting the use of polyvinyl chloride in the food packaging industry. Non-toxic stabilizers for the rigid vinyls are badly needed.

Due to the large amount of testing required, development of satisfactory non-toxic stabilizers will undoubtedly require subsidizing by the producers of the polymer. Some work is going forward by the stabilizer makers, but it is necessarily limited.

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STYRENES

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(Continued on next page)

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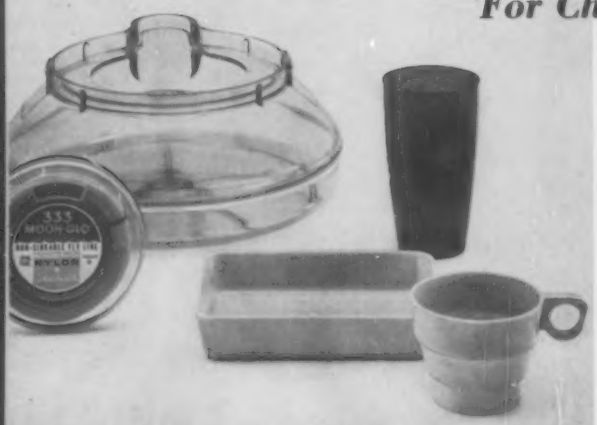
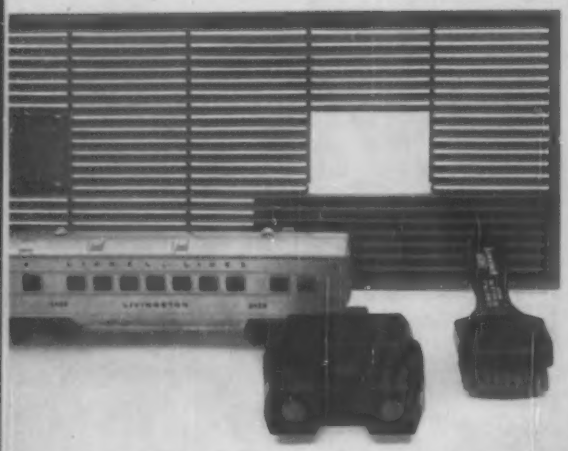


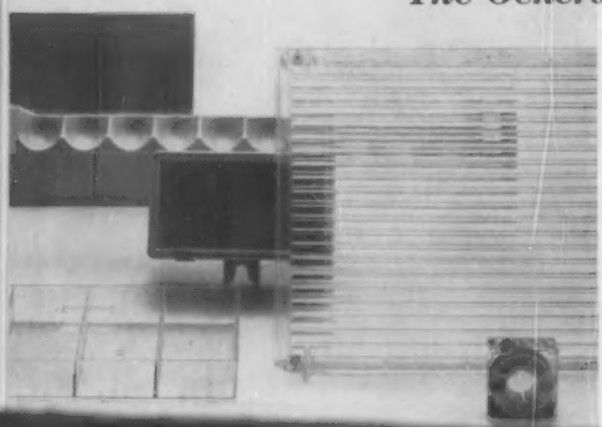
This acrylonitrile-styrene copolymer, known as C-11 plastic, is particularly outstanding in chemical resistance and strength properties. It is especially desirable for molded articles where crazing may be a problem. Articles molded from RMD-4511 are resistant to most of the chemicals common to households; detergents, foods, and cleaners which attack the surfaces of many plastics. This combination of properties makes RMD-4511 ideal for molded housewares, packages, and appliance parts. Its utility is enhanced by a full range of available colors.

For Impact Resistance TMD-5151



This rubber-modified polystyrene combines high impact strength and good molding properties. It is available in a wide range of bright opaque colors. TMD-5151 has a low bulk factor, flows freely, and sets up quickly. Articles molded from TMD-5151 demonstrate good electrical properties, superior mechanical strength, and excellent appearance. The Izod impact strength of this material is as much as five times that of general-purpose polystyrene.

The General-Purpose Styrene SMD-3500



Free-flowing SMD-3500 is a general-purpose compound that combines excellent moldability and fast setup. It is available in a crystal clear formulation or in a wide range of brilliant colors. This material has a low bulk factor and good electrical, mechanical, and optical properties. SMD-3500 is widely used for injection molding operations requiring superior ease of molding.

For applications such as packaging where extra-high flow is desired, *SMD-3700* is recommended for best performance on fast cycles.

TYPICAL PROPERTIES	RDM-4511 (formerly BMC-11) Acrylonitrile-Styrene Copolymer	TMD-5161 Impact- and Heat-Resistant	SMD-3500 General-Purpose Polystyrene	TMD-2155 Extra-High-Impact Polystyrene	TDM-5151 High-Impact Polystyrene
Values Relating to Fabrication					
Specific Gravity (D792-50) (Varies slightly with color)	1.07	1.04	1.05	1.03	1.04
Weight per Cubic Inch (Molded) gms.	17.5	17.0	17.2	16.9	17.0
Bulk Factor (D1182-54) Diced	1.98	—	1.98		
Pellet	1.71	1.72	1.71	1.71	1.71
Molding Shrinkage (D955-51), in./in.	0.004	0.004	0.005	0.005	0.005
Values from Electrical Tests					
Dielectric Strength (D149-55T) Short time, volts/mil	420	460	640	515	460
Dissipation Factor (D150-54T) At 60 c., 1 kc., 1 mc.	.007	.002	.0002	.001	.001
Dielectric Constant (D150-54T) At 60 c., 1 kc., 1 mc.	2.75	2.60	2.45	2.50	2.60
Volume Resistivity (D257-54T) ohm-cms.	$>10^{14}$	$>10^{14}$	$>10^{14}$	$>10^{14}$	$>10^{14}$
Values from Mechanical Tests					
Izod Impact Strength (D256-54T) ft-lb/in. of notch					
⅛ in. thick	0.55	2.6	0.47	8.0	2.3
¼ in. thick	0.45	1.1	0.33	3.6	1.0
Tensile Strength (D638-52T), psi	12,000	6,700	7200	4300	4000
Elongation in Tension (D638-52T), per cent	3.2	5	2	25	28
Flexural Strength (D790-49T), psi	17,300	9,200	9500	No failure	No failure
Modulus of Elasticity in Flexure (D790-49T), psi	5.2×10^5	3.9×10^5	4.5×10^5	2.75×10^5	3.7×10^5
Values from Miscellaneous Tests					
Heat Distortion Temp. (D648-45T) (264 psi) deg. F.					
⅛ in. thick		189			
¼ in. thick	200	192	183	184	173
½ in. thick		198			
Thermal Coefficient of Linear Expansion (D696-44) per deg. C.	7×10^{-5}	7.5×10^{-5}	7×10^{-5}	7.5×10^{-5}	7.5×10^{-5}
Water Absorption (D570-54T), per cent gain in weight in 24 hours	0.23	0.140	.04	0.14	0.10
Rockwell Hardness (D785-51)	M83	L78	M67	L25	L71

For Impact and Heat Resistance TMD-5161

A new compound, TMD-5161 is a rubber-modified material that combines these two important characteristics. Rugged tests have proven its superior mechanical strength, high resistance to heat distortion, and good electrical properties. It comes in an almost unlimited range of opaque colors. Finished moldings have a rich, high gloss. TMD-5161 assures intricate injection molded pieces produced on fast cycles with higher economy. Suggested applications include radio cabinets, photographic equipment, electric fan housings, vacuum cleaner parts, and air conditioner grilles.

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Even at temperatures of −25 deg. C., this rubber-modified polystyrene possesses extra-high-impact strength. Compared to the general-purpose styrenes, it has an Izod impact strength approximately eighteen times as great. TMD-2155 is supplied in a variety of bright opaque colors. It retains the excellent molding characteristics for which styrenes are noted—ease of flow at molding temperature, fast cycles, good mold release, and a minimum of strain and weld lines. In addition, it exhibits a high heat distortion point, together with superior surface gloss and excellent color.

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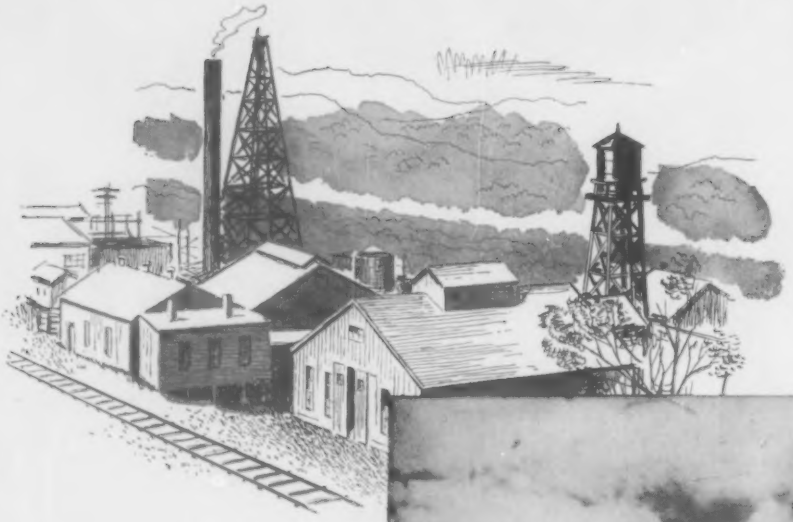

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Resin emulsion density-solids relationships

*By Leonard Shapiro**

The determination of the density of resins present in an emulsion is helpful in identification of resins and in calculation of the relation between solid content and emulsion specific gravity. The fact that the resin density can be determined from a solid content and a specific gravity determination is not so well known, and the calculations are described below. The nomographic solution to the problem is satisfactory to two decimal places.

If the resin emulsion is assumed to consist entirely of solid particles of density d_r, dispersed in a liquid of specific gravity d_l, the simple determination of resin solids r and emulsion specific gravity d_e is all that is required. The calculation is as follows:

d_r = density of resin solid
d_l = density of liquid phase
d_e = density of resin emulsion
r = resin (weight) fraction of emulsion
$1-r$ = liquid (weight) fraction of emulsion
$1/d_r$ = specific volume of resin
$1/d_l$ = specific volume of liquid
$1/d_e$ = specific volume of emulsion

Since the volume of resin plus the volume of liquid is equal to the volume of emulsion:

$$\frac{r}{d_r} + \frac{1-r}{d_l} = \frac{1}{d_e} \qquad \text{Eq. 1}$$

Multiplying by $d_r d_l d_e$:

$$rd_l d_e + d_r d_e - rd_r d_e - d_r d_l = 0 \qquad \text{Eq. 2}$$

$$d_r (d_e - d_l) = rd_e (d_r - d_l) \qquad \text{Eq. 3}$$

$$\frac{d_r - d_l}{d_r} \cdot r = \frac{d_e - d_l}{d_e} \qquad \text{Eq. 4}$$

In the simplest case, where the density of the liquid phase is virtually equal to 1, the equation becomes

$$\frac{d_r - 1}{d_r} \cdot r = \frac{d_e - 1}{d_e} \qquad \text{Eq. 5}$$

*The Borden Co., Chemical Div.

and the computation, with the aid of a table of n versus $(n-1)/n$ values is fairly simple (see Table I).

Nomographic solution

The construction of a nomogram for solution of this equation is fairly simple, and one form applicable to most commercial resin emulsions is illustrated in Fig. 1, p. 248.

Table I: Values of n versus $(n-1)/n$

n	$(n-1)/n$
0.90	—0.091
0.95	—0.0525
1.00	0
1.05	0.0476
1.10	0.091
1.15	0.1305
1.20	0.167
1.25	0.200
1.30	0.231
1.35	0.260
1.40	0.286
1.45	0.310
1.50	0.333
1.55	0.355
1.60	0.375
1.65	0.394
1.70	0.411
1.80	0.445
1.90	0.474
2.00	0.500
3.00	0.667
4.00	0.750
5.00	0.800

The emulsion density scale has been graduated in both pounds per gallon (U.S.) and in specific gravity units. The solid resin density scale has been graduated also to indicate the densities of a number of resins commercially available in emulsion form. (Densities and specific gravities have been assumed to be equal.)

While the resin density indicates some probability of its identity, it is certainly not conclusive. Thus, a density of 1.19 may indicate that the resin is polyvinyl acetate, but it could also equally well indicate a mixture or copolymer of styrene and vinyl chloride.

Example 1: A resin emulsion is found to have a specific gravity of 1.10 and solid content of 55 percent. A line through the 55% point on the resin solids scale intersects the solid density scale at 1.19 (corresponding to polyvinyl acetate).

Example 2: If a 55% resin emulsion (as above) has a specific gravity of 1.10, to determine its specific gravity on dilution to 35% solids, find resin density as in Eq. 1, then connect this point (1.19) with 35 on the percent solids scale. This line intersects the emulsion density at 1.058 (= 8.8 lb./U. S. gal.).

Example 3: A resin emulsion contains 45% solids and weighs 10 lb./U. S. gal. To determine density and probable type of resin draw a line through these two values on the appropriate scales, locating the intersection on the third scale at 1.59 (corresponding approximately to a vinyl chloride-vinylidene chloride copolymer containing 35 to 40% vinyl chloride and 60 to 65% vinylidene chloride).

Effect of dissolved solids

The fact that resin emulsions generally contain a few percent of water-soluble surfactants and protective colloids seems to invalidate Eq. 5 since liquid density

(*To page* 248)

Plastics Digest*

Abstracts from the world's literature of interest to those who make or use plastics or plastic products. For complete articles, send requests direct to publishers. List of addresses is at the end of Plastics Digest.

Materials

Evaluation of low-dielectric glass fabric. F. Werren and B. G. Heebink. Wright Air Development Center Technical Report 56-264 (Oct. 1956). Glass fabric-base plastic laminates, reinforced with fabric made of low-dielectric glass fibers and standard "E" glass fibers, were evaluated on the basis of mechanical and electrical properties. Six different laminating resins were used. Comparative data obtained from these tests showed that laminates made with low-dielectric fabric were superior in electrical properties but inferior in mechanical properties to comparable laminates made with the standard "R" glass fabric.

Use of epoxy resins in synthetic rubber compositions. T. F. Mika. J. Appl. Chem. *6*, 365-75 (Sept. 1956). An attempt was made to combine epoxide resins and rubbers so that the disadvantages of each could be obviated by the presence of the other. A graft polymer containing anhydride groups from the reaction of maleic anhydride and a nitrile rubber served as a base to establish the reactivity of an epoxide resin in this system. An epoxide resin in the presence of a tertiary amine vulcanized the anhydride rubber with resulting improvements in physical properties and solvent resistance. Similar results were obtained with a commercially available rubber based on copolymers of acrylate esters with acrylic type acids and containing reactive carboxylic groups. Natural rubber, butadiene-styrene and butadiene-acrylonitrile copolymers do not contain groups reactive with epoxide resins; however, the curing mechanisms for these rubbers involve the formation of functional groups potentially reactive with epoxides. The intermediate thiol groups formed in the reaction of a nitrile rubber with sulfur were found to coreact with epoxide resins. Under such conditions, the epoxide resin acts as a reinforcing agent for the rubber, contributing improved solvent resistance and increased tear strength.

Foam plastics. W. Brenner. Materials & Methods *43*, 143-58 (June 1956). The chemical composition, physical and mechanical properties, forming and fabrication, and applications of foam plastics are comprehensively discussed. The commercially available plastics foams include urethane, vinyl chloride, polyethylene, polystyrene, phenolic, silicone, cellulose acetate, epoxy, and urea formaldehyde types. Forms of foam plastics include flexible, rigid foamed in place, and rigid prefoamed cellular resins. So-called syntactic foams are formed by filling a conventional casting resin with tiny nitrogen-filled Microballoons. This provides a foam with spherical cells which have greater inherent strength than conventional polyhedral-shaped cells common in chemical reaction type foams. The density of the syntactic foam is controlled by altering the ratio of Micro balloons to casting resin. The microscopic spheres are either phenolic or urea materials; they can be used to fill polyester, epoxy, and other selected casting resins.

Polyester laminating resins—Part 2. J. Brydson. Plastics (London) *21*, 323-24 (Nov. 1956). Methods of producing gelation in polyesters, other than by using a peroxide and naphthenate, are discussed. These include light gelation, thermal gelation, gelation by benzoyl peroxide at elevated temperatures, gelation by benzoyl peroxide and amines, and use of cobalt naphthenate without peroxides. An uncured polyester resin may be evaluated from the following information: acid value, gel time, viscosity, and styrene content. Methods for determining these properties are described.

Molding and fabricating

Injection molding of thermosetting materials. Westinghouse Eng. *17*, 32 (Jan. 1957). A process for injection molding of thermosetting materials is described.

The molten bead sealer. H. G. Chinn. Modern Packaging *30*, 153-56, 214 (Dec. 1956). A new method for sealing polyethylene film and laminates as well as other thermoplastic films is described. The sealer can be used where high-speed sealing is desired and in applications in which it is difficult to get heat through thick films or laminates. Basically, this is accomplished by extruding a hot filament of polyethylene between two layers of film instead of attempting to drive heat through one of the layers. Speeds in excess of 500 ft./min. have been attained and a straight, continuous, tough seal is made.

Applications

New standard for crash helmets. Brit. Plastics *29*, 440-41 (Dec. 1956). A revised British Standard for protective helmets for motor cyclists has been issued. The main differences have to do with testing procedures, especially for impact resistance and resistance to penetration.

Properties

Density, infra-red absorption, and crystallinity in 6/6 and 6/10 nylons. H. W. Starkweather, Jr. and R. E. Moynihan. J. Polymer Sci. *22*, 363-68 (Dec. 1956). The intensities of crystalline and amorphous infra-red bands of 6/6 and 6/10 nylon films are plotted against density. The curves are extrapolated to zero intensity to give revised values for the amor-

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phous and crystalline densities which are probably more accurate than those previously used. The amorphous density of 6/10 nylon is in agreement with the value previously measured on quenched films, but the amorphous density of 6/6 nylon is about 2% lower. The new values for the crystalline densities are somewhat lower than those calculated from X-ray diffraction data.

Effect of branching on dynamic mechanical properties of polyethylene. D. E. Kline, J. A. Sauer, and A. E. Woodward. J. Polymer Sci. 22, 455-62 (Dec. 1956). The effect of chain branching on the dynamic mechanical properties of polyethylene within the temperature region 80 to 380° K. was studied using an apparatus that drives rod-like specimens in their transverse modes. The results for three types of polyethylene having 3.2, 1.6, and less than 0.1 branches per 100 carbon atoms of the main chain are compared and discussed. Experimental results indicate that all of the three main dispersion regions (α, β, γ) characteristic of polyethylene are affected to some extent by branching. The β region, starting near 230° K., decreases with decreased branching, and for polyethylene that has negligible branching it is almost entirely absent. This suggests a direct relation between the number of branch points and the size and shape of this peak. The γ dispersion region near 170° K. appears sharper and shifted to higher temperatures with decreased branching, this being attributed to a narrowing of the relaxation times associated with the movement of a small number of CH_2 units. The α dispersion region near 370° K. is also shifted to higher temperatures with decreased branching in accord with the shift of melting temperature with degree of crystallinity.

Radiation-induced conductivity in polyethylene and Teflon. R. A. Meyer, F. L. Bouquet, and R. S. Alger. J. Applied Phys. 27, 1012-18 (Sept. 1956). The conductivity induced in polyethylene and Teflon by bombardment with X-rays from a 2-m.e.v. Van de Graaff and gamma rays from Co^{60} was investigated as a function of time, temperature, geometry, exposure rate, and applied electric field. Within the range of the variables studied, the observed photocurrents were directly proportional to the exposure rate and the applied electric field. The photocurrent could be divided into three components, the current due to the action of monodirectional photons, the increase in this current due to the influence of the electric field, and a component of less than 10% made up of all other possible charge carriers. During irradiation, the conductivity increased by a factor of about 10^3. Between 78° K. and 273° K. the photocurrent was nearly independent of temperature. In general, the conductivity of Teflon was greater than that of polyethylene.

Testing

A mechanism to operate a tension tester at constant strain rates. S. Strella. A.S.T.M. Bulletin, No. 219, 29-33 (Jan. 1957). Apparatus is described for making tension tests at constant rates of strain. Results for several plastics materials are presented. The data indicate that tension tests made at constant rate of strain are superior to those made at constant rate of grip separation.

Measurement of the elastic modulus of films. J. R. Olson and D. W. Vanas. A.S.T.M. Bulletin No. 219, 34-35 (Jan. 1957). Analysis of effect of gage length on apparent modulus of elasticity of film materials shows that slippage of the specimen in tester can cause serious measurement errors. Special gripping techniques can reduce but not eliminate this error. Data show the slippage to be a determinate constant of the material and the apparatus, thus permitting the true value of the modulus to be calculated and providing a check on the efficacy of any given gripping procedure.

A recording apparatus for measurring the dynamic mechanical properties of polymers. D. E. Kline. J. Polymer Sci. 22, 449-54 (Dec. 1956). An apparatus for measuring the dynamic mechani-

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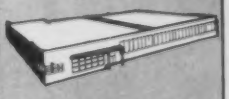

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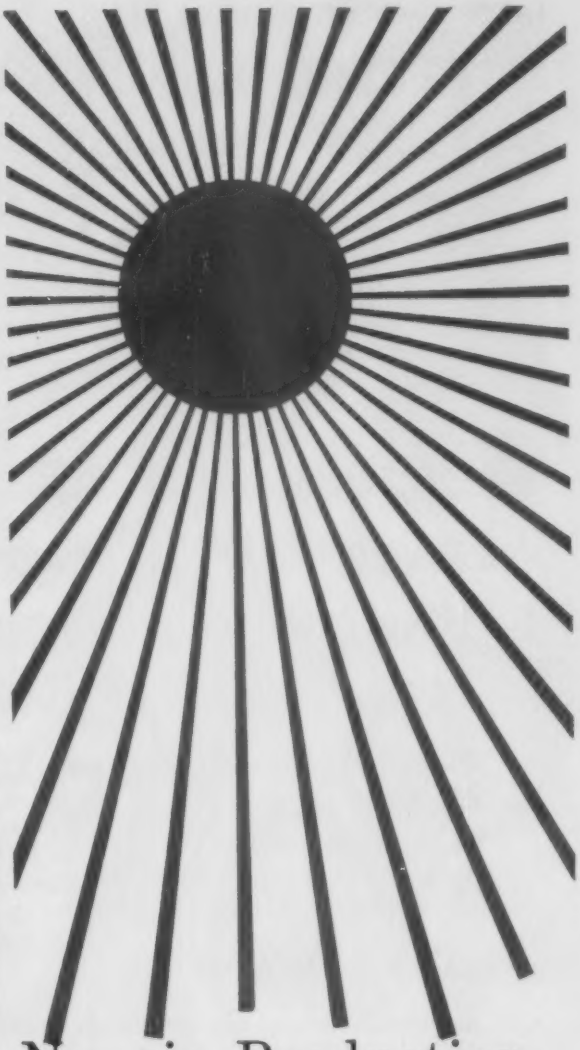

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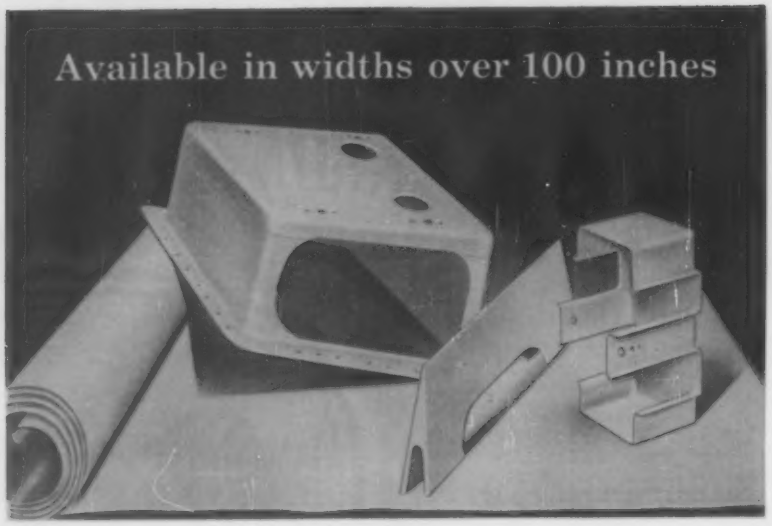

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cal properties of polymers is described. Rod-like specimens are driven through a transverse resonant mode by changing the driving frequency. The specimen response is obtained and automatically plotted by a recorder. Resonant frequency and width of the resonance curve constitute a measure of the dynamic mechanical properties. The temperature range of the apparatus is 4° K. to more than 600° K., and the frequency range is at least 50 to 5000 c.p.s. Damping values have been measured from 10^{-4} to 5×10^{-1}.

PhotoStress. F. Zandman and M. R. Wood. Product Eng. *27*, 167-78 (Sept. 1956). A new technique, "PhotoStress," for observing and measuring surface stress on actual structures and parts, using a transparent plastic coating that becomes doubly refractive when stressed, is described. Advantages and limitations of the method, basis for selection of the plastic material, measurement of birefringence, and determination of the magnitude and direction of stress are discussed. Several case studies are given. Optical principles and definitions and a mathematical derivation of the theory are presented. The PhotoStress technique is applicable to any material, irrespective of size or shape, at any point on the surface accessible to light, whether the stress results from static or dynamic loads, for any stress gradient up to the point of rupture, at temperatures from —67 to 284° F., under any atmospheric conditions and when immersed in liquid. The method can be used in plant, field, or laboratory.

Bond tester for coatings. J. E. Guillotte and C. P. MacDermott. Modern Packaging *30*, 157-60, 211 (Dec. 1956). An evaluation of the Perkins-Southwick bond tester as a quantitative measure of adhesion of polyethylene to papers is presented. The test is simple and fast and can be used as a quality control test in extrusion coating. This bond tester is sufficiently precise and accurate to use in the determination of various levels of adhesion. The latter includes those coating operations where a

bond only sufficient for handling purposes is desired, as well as those applications where a bond strength which is as great as that of the coated paper itself is desired.

Chemistry

Copolymerization of vinyl siloxanes with organic vinyl monomers. R. M. Pike and D. L. Bailey. J. Polymer Sci. *22*, 55-64 (Oct. 1956). A series of simple vinyl siloxanes containing monofunctional, difunctional, and trifunctional silicon atoms was copolymerized with various organic vinyl monomers. It is possible to predict the behavior of vinyl siloxanes of complex structure in copolymerization reactions with these vinyl monomers. The structure of the vinyl siloxane does not appreciably affect the total rate of copolymerization or its reactivity toward a given organic vinyl monomer. Vinyl siloxane monomers have comparable reactivities to monomers such as vinyl acetate, vinyl chloride, and perfluorovinyl chloride but are less reactive than acrylonitrile, styrene, and N-vinylpyrrolidone. In copolymerization reactions involving vinyl siloxanes the total polymerization rate and the molecular weight of the copolymers are markedly affected by the amount of vinyl siloxanes in the monomer mixture. An increase in the percentage of vinyl siloxane used in the monomer mixture results in a decrease in the polymerization rate, which in turn results in the production of copolymers having lower molecular weights.

Publishers' addresses

A.S.T.M. Bulletin: American Society for Testing Materials, 1916 Race St., Philadelphia, Pa.

British Plastics: Iliffe and Sons, Ltd., Dorset House, Stamford St., London S. E. 1, England.

Journal of Applied Chemistry: Society of Chemical Industry, 56 Victoria St., London S. W. 1, England.

Journal of Applied Physics: American Institute of Physics, 57 E. 55th St., New York 22, N. Y.

Journal of Polymer Science: Interscience Publishers, Inc., 250 Fifth Ave., New York 1, N. Y.

Materials and Methods: Reinhold Publishing Corp., 430 Park Ave., New York, N. Y.

Modern Packaging: Modern Packaging Corp., 575 Madison Ave., New York 22, N. Y.

Plastics (London): Temple Press Ltd., Bowling Greene Lane, London E. C. 1, England.

Product Engineering: McGraw-Hill Publishing Co., 330 W. 42nd St., New York 18, N. Y.

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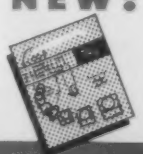

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Adhesives. N. H. Shearer, Jr. and H. W. Coover, Jr. (to Eastman Kodak). U. S. 2,776,232, Jan. 1. Mixed alpha-cyanoacrylate adhesives.

Foamed plastisols. M. F. Fuller (to Du Pont). U.S. 2,776,265, Jan. 1. Process for blowing plastisols.

Resin. M. T. Harvey (to Harvel). U. S. 2,776,266, Jan. 1. Partially hydrogenated furfural-ketone reaction product.

Copolymerization. A. P. Richard (to Societe des Glaces et Produits Chimiques). U. S. 2,776,273, Jan. 1. Copolymerization of vinyl chloride and vinylidene chloride.

Resins. J. P. Buckmann (to Union Oil). U. S. 2,776,949, Jan. 8. Amide-aldehyde resins from amides of oxidized paraffin acids.

Resins. F. G. Lum and E. F. Carlston (to California Research). U. S. 2,776,950, Jan. 8. Polyamide resins from 5-tert-butyl-*m*-xylylene diamine.

Amides. S. Melamed (to Rohm and Haas). U. S. 2,776,951, Jan. 8. Polymers of amides of vinyl ethers containing hydroxyl groups.

Polymerization. H. Bredereck, E. Bader, W. Nubling, and A. Wohnhas (to W. C. Heraeus). U. S. 2,776,-952, Jan. 8. Using halogen compounds to promote sulfone polymerization catalysts.

Polymerization. M. A. Taves (to Hercules). U. S. 2,776,953-4, Jan. 8. Catalyst system for polymerization.

Cyclic compounds. L. A. Errede and B. F. Landrum (to M. W. Kellogg). U. S. 2,777,005, Jan. 8. Polymerizable cyclic compounds.

Electrode structure. J. M. Lafferty (to General Electric). U. S. 2,777,084, Jan. 8. Plastic electrode structure for electron tubes.

Molding. A. M. Strahm. U. S. 2,-777,164, Jan. 15. Injection molding machine.

Reproduction fixtures. S. P. Kish. U. S. 2,777,790, Jan. 15. Making dies, models, assembly fixtures with a thermosetting mastic.

Resin. H. R. Leeds (to Perma-Stamp Products). U. S. 2,777,824, Jan. 15. Microporous structure of thermoplastic resin dispersed with a non-solvent liquid.

Plastic. M. L. A. Fluchaire and J. A. Phelisse (to Societe des Usines Chimiques Rhone-Poulenc). U. S. 2,777,825, Jan. 15. Cellulosic plastic compositions.

Polymers. H. M. Olson (to Harshaw). U. S. 2,777,826, Jan. 15. Vinyl chloride polymers stabilized with carboxylic acid salts and organic titanates.

Stabilizers. H. M. Day, V. E. Hasler and W. S. Forster (to American Cyanamid). U. S. 2,777,828, Jan. 15. Hydroxybenzophenones as stabilizers for polyester resins.

Alkyd resin. R. C. Andrews and N. G. Peterson (to Glidden). U. S. 2,777,829, Jan. 15. Alkyd resins stabilized with choline chloride.

Isocyanate-modified polyesters. N. V. Seeger and T. G. Mastin (to Goodyear). U. S. 2,777,831, Jan. 15. Storable isocyanate-modified polyesters.

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Polymerization. W. R. Richard, Jr. (to Monsanto). U. S. 2,777,833, Jan. 15. High pressure polymerization for ethylene-1-chloro-1-fluoroethylene.

Copolymerization. J. D. Calfee (to Monsanto). U. S. 2,777,834-5, Jan. 15. Copolymerization of vinyl chloride with vinylidene chlorofluoride.

Polymers. K. B. Everard and I. Harris (to Imperial Chemical). U. S. 2,777,836, Jan. 15. Production of vinyl chloride polymers.

Condensates. M. B. Unger (to Sherwin-Williams). U. S. 2,777,837, Jan. 15. Oleoresinous rosinamine condensates.

Polymerization. R. Y. Mixer and D. L. Bailey (to Carbide and Carbon). U. S. 2,777,868-9, Jan. 15. Polymerization of vinyl alkoxysilanes.

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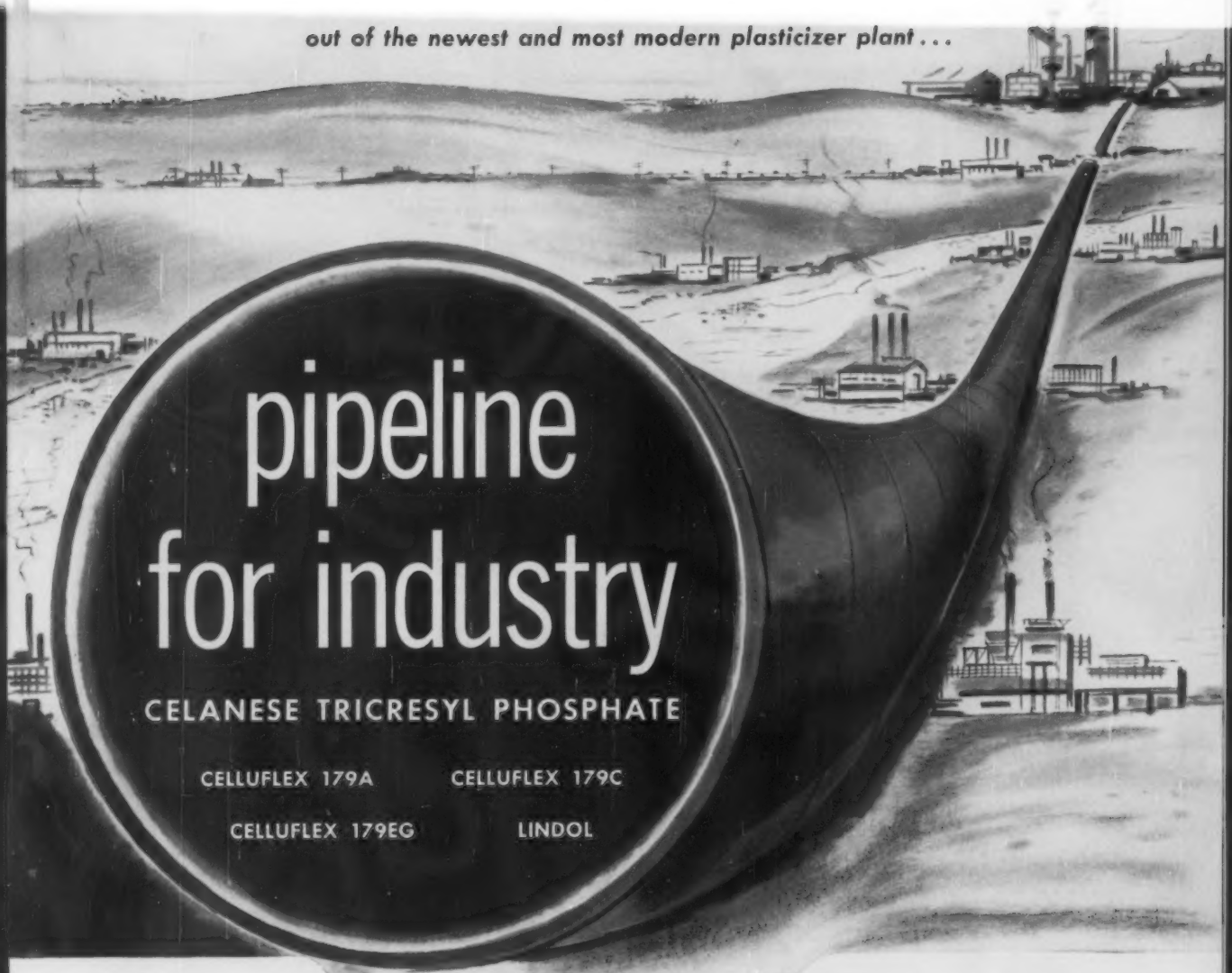

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Extruders. A. D. Rutherford, Jr. (to Western Electric). U. S. 2,779,-696, Jan. 29. Cleaning the interior of extruders with aqueous slurries of granular polyvinyl chloride.

Resins. P. Robitschek and C. T. Bean, Jr. (to Hooker). U. S. 2,779,-700-1, Jan. 29. Polyester resins containing halogen.

Resins. E. H. Schwencke (to Elastomer Chemical). U. S. 2,779,743, Jan. 29. Plasticizing vinyl resins.

Copolymer. R. H. Snyder (to U. S. Rubber). U. S. 2,779,748, Jan. 29. Composition of polyvinyl chloride and a diolefin-dialkyl fumarate copolymer.

Resins. J. E. Wicklatz (to Phillips). U. S. 2,779,749, Jan. 29. Stabilized unsaturate-sulfur dioxide resins containing acrylates.

Resin. M. C. Fugua and G. P. Hammer (to Esso). U. S. 2,779,750, Jan. 29. Aluminum chloride catalyzed polymerization of clay-pretreated naphthas.

Polymerization. H. Bredereck, E. Bader, A. Wohnhaas, and W. Nubling (to W. C. Heraeus). U. S. 2,-779,751, Jan 29. Polymerization using sulfone-containing accelerators.

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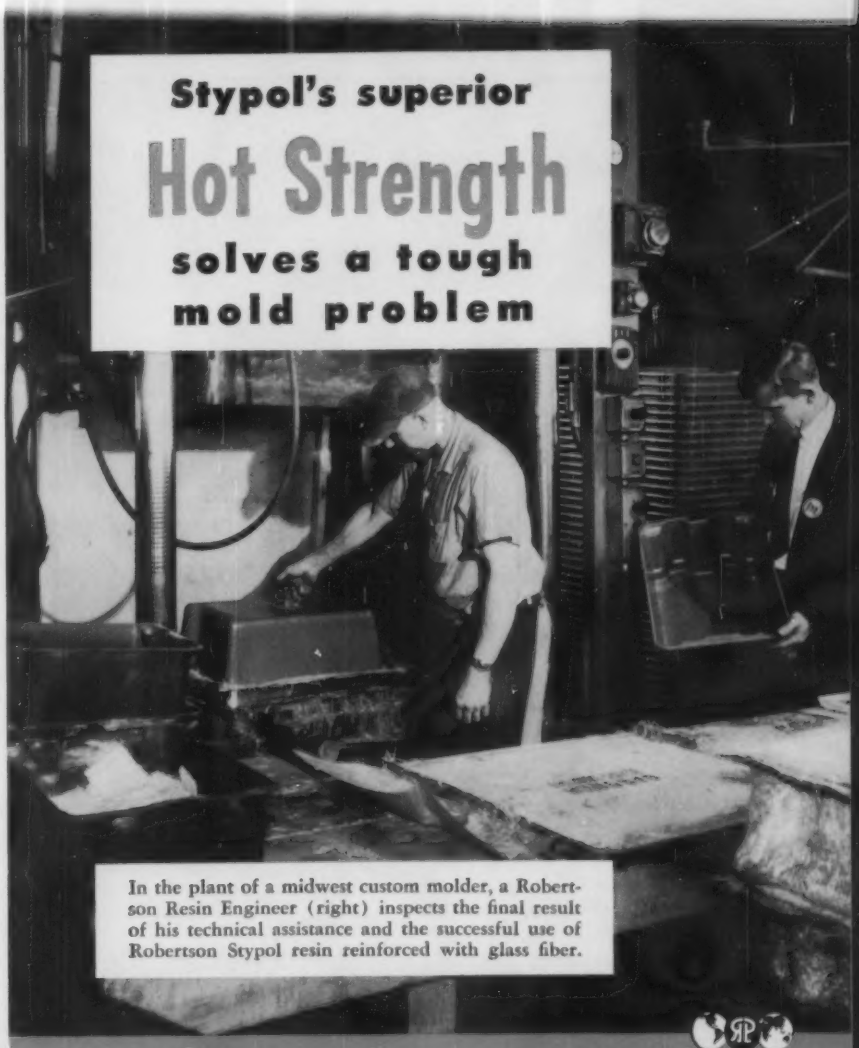


In the plant of a midwest custom molder, a Robertson Resin Engineer (right) inspects the final result of his technical assistance and the successful use of Robertson Stypol resin reinforced with glass fiber.

Robertson Stypols (polyesters) offer outstanding craze and blow resistance on short high temperature cure cycles plus far better than average hot strength and mold release properties, particularly in complex large moldings. One of the Stypols resists crazing in paint oven systems up to 260°F. In addition, these resins have an unusual ability to bury fibers so that the surface of molded parts is very smooth to the touch. Clip the coupon below and attach it to your letterhead if you would like a qualified Robertson engineer to work in your shop with you on your specific problem.

ROBERTSON **STYPOL** RESINS

*One of the world's largest producers of specialty asphaltic and polyester compounds

H. H. ROBERTSON CO.

2444 Farmers Bank Building Pittsburgh, Pa.

NAME

COMPANY

ADDRESS

New Machinery and Equipment*

Heat sealer makes multi-color appliques in vinyl

A heat sealing machine (U. S. Pat. No. 2,747,646) combines radiant heating with dielectric heating to make possible two- or three-color tear-sealing of appliqués on vinyl sheet. Under certain conditions more than three colors can be used. The latest model (CA 3000) of this machine is furnished with a circular indexing work table fitted with work holders that combine the best features of screw clamping and magnetic clamping to give a versatile, fast, solid clamping action for fast, accurate work. The turn-table can be removed in seconds if desired. A roll feed attachment increases the machine's versatility.

General characteristics are: Power input; 40 amp. at 220 v., single phase. RF output; 3 kw., raised to 4 kw. with special g'mmick, the Cosmo-Chrome. Two 15-sec. timers and two oscillators with cooling fans, are standard equipment. The platen is 10 by 12 in. in area.

An electric-eye safety device cuts out the HF generator if the beam is interrupted on any of the three sides from which the die can be approached. Other safety features include two-button operation, low-voltage circuit, and arc eliminator. Essential for appliqué work are special dies designed for use with the machine. Duty cycle is 75 percent. Other models ranging from 1 to 25 kw. in output are available. *Cosmos Electronic Machine Corp., 656 Broadway, New York 12, N.Y.*

Pelletizers

The Series 700 multiple-knife cutters are designed primarily for cutting cold plastics extruded in rod form (spaghetti) at high linear rates. The throat entrance is approximately horizontal and the width may be 5.6, 9.6, 11.6, or 13.6 in., ±0.1 inch. The rotating element contains 24 cutting blades mounted in such a way that the cutting action resembles that of a reel-type lawn mower, i.e., one end of each blade reaches the fixed (or bed) knife before the other end does. This distributes the working load, reducing shock to blades, mountings, and transmission. Feed rolls, one spring loaded, assure uniform feed. Low extrusion rates may be accommodated by removing some of the blades. Sheet stock may also be cut satisfactorily into strips with these cutters. *Taylor, Stiles & Co., Riegelsville, N. J.*

Sleeving cutter

Sleeving up to ¼-in. O.D. can be cut at rates up to 10,000 pieces per hr. with the "Little Joe 101," which will cut all insulation tubing, including such tough ones as fibrous glass sleeving and tubing made from silicone-coated nylon. It can also cut wires up to 16 gage. The standard model is cranked by hand but can easily be motorized. The cutter can be adjusted to cut any length from 1/32 in. to 2 in., with a "tolerance" of 1/32 inch. Over-all dimensions are only 5 by 5.5 by 6 inches. *MacDonald and Co., 1324 Ethel St., Glendale 7, Calif.*

Hot-gas welder

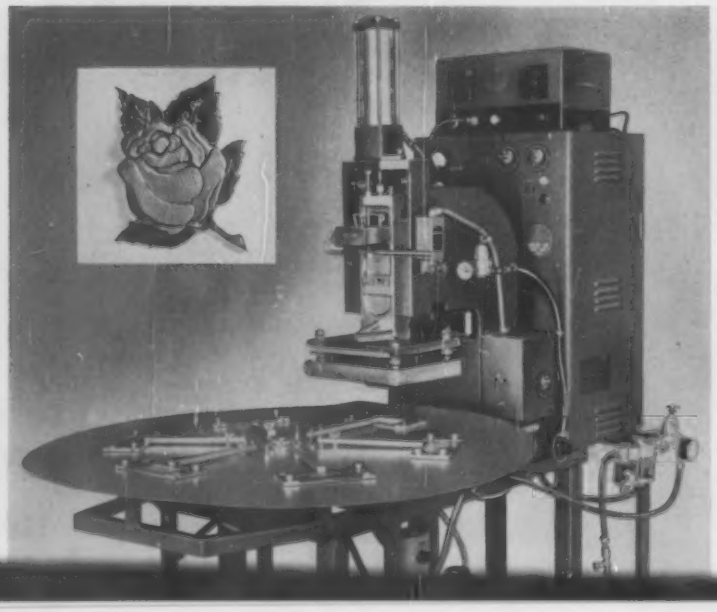
Greater versatility and easier handling are claimed for the Model P plastic welder. Heating elements are extra sturdy; standard heater delivers 320 w., but heaters of 180, 240, and 600 w. are available on request. Elements can be changed in a few minutes and the range of wattages permits the safe welding of all thermoplastics from thin polyethylene to thick PVC. A molded plastic handle gives both better grip and better insulation than handles of earlier models. *Seelye Craftsmen, 984 Central Ave., Minneapolis, Minn.*

Sheet forming machines

Welding Engineers, Inc., is now offering four versatile sheet forming machines of its own manufacture. Amvac models H-3, -4, and -6 are single-station machines having effective molding-table areas of 2 by 3 ft., 3 by 4 ft., and

*Specifications and claims made and appearing in these pages are those of the manufacturers of the machinery and equipment described and are not guaranteed by MODERN PLASTICS.

Cosmos Electronic heat sealing machine Model CA-300 combines radiant and dielectric heating which permits two- or three-color tear sealing of appliques on vinyl sheet. (See inset)



ADDRESS

Van Dorn

MODEL H-250 PRESS 2½ OZ.

is FAST!

Up to 1200 cycles per hour (dry run)

AUTOMATIC!

One operator can run 3 or more presses, for greater flexibility, and lower labor costs. Selective control permits semi-automatic operation.

EASILY OPERATED!

by semi-skilled help. With simple, handy controls, job can be set up in 20 minutes.

VERSATILE!

The sketches list only a few of the many thermoplastics molded on Van Dorns.

Made at Low Cost on VAN DORNS

Polystyrene Containers — over 720 per hour

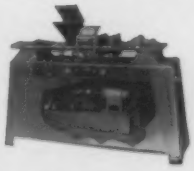
Vinyl Cord Sets —over 2000 per hour

Polyethylene Closures — over 9000 per hour

Nylon Coil Forms — over 2000 per hour

Remember, For the Price of One Large Press, You Can Own a BATTERY of VAN DORNS!

SEMI-AUTOMATIC PRESS 2-oz. capacity.

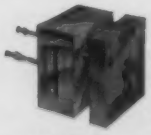


POWER OPERATED, LEVER CONTROLLED PRESSES 2-oz. and 1-oz. models.

WRITE FOR complete data on model H-250 and other equipment shown.

FINANCING AVAILABLE

PLASTIC GRINDER Grinds up rejects, waste, etc., for re-use.



MOLD BASES Available from stock.

THE VAN DORN IRON WORKS CO., 2685 EAST 79th ST. • CLEVELAND 4, OHIO

Welding Engineers
Amvac sheet forming machine from the H series

4 by 6 ft., respectively. The HR-6 is a rotary four-station unit. Dimensions, etc., of all four are listed in Table I. While the machines can be manually controlled, each is instrumented with timers, table control, table speed control, and temperature control to permit automatic operation. Heaters are about the same size as the effective forming areas, and a choice of three types of heaters is offered: Calrod, quartz, or metal sheath. Safety features include gates which must be closed to operate the machine, locking devices that prevent operation while maintenance work is going on, as well as standard safety features required of heavy equipment. All four models may be had with the optional extras of plug-assist and air-slip techniques. "Ruggedness for continual production" was the goal in the design and construction of these formers. All four machines can handle sheets ranging in thickness from 10 to 250 mils. Utilities required are: air at 80 to 100 p.s.i.g., cold water, and a 220- or 440-v. power supply, as desired. *Welding Engineers, Inc., Norristown, Pa.*

Granulator

The Rotoplex cutting granulator, made by Alpine A.G. of Germany, is able to handle a wide variety of materials and to produce uniform granules. Besides the tougher plastics, the granulator can handle scrap leather, cured and uncured rubber, and textile products. It is offered in three sizes—the 16/8, 16/18, and 32/40—which designations refer to the diameter and width of the cutting rotors in millimeters. The 32/40 is optionally supplied with a cooling fan and cyclone separator for working especially heat-sensitive or warm plastics. The two larger models are equipped with 4.5- and 12.5-hp. motors that normally draw about half that horsepower with continuous feeding of the cutter. The rotor of the 32/40 is supported at both ends, and all three are top-opening. *Represented in U.S. by Lukens Laboratories, Inc., 227 California St., Newton 58, Mass.*

Automatic spray-painting machine

This machine has a rotary mask fixture mechanism and should be of particular interest to those who decorate parts with slow-drying paints or with materials of high viscosity. Parts may be dried, by infra-red lamps or hot air, thoroughly enough to permit stacking and handling immediately after removal from the machine. Since the paint hitting the masks is dried between shots, the number of shots between mask changes is usually doubled, and masks can be used until shadowing occurs. Working parts are totally enclosed. A self-contained exhaust system makes a spray booth unnecessary. The machine can be furnished with any desired number of stations, with manual or automatic hold-downs and indexing. *Conforming Matrix Corp., 364 Toledo Factories Bldg., Toledo 2, Ohio.*

Thermoset preheater

The Thermex Model 3RB preheater, rated at 3 kw. output, can heat its maximum load of 2.5 lb. of G.P. phenolic from 80 to 250° F. in 60 sec., or a 9-oz. load in 15 seconds. Preforms up to 3.7 in. high can be accommodated. A new controller senses the temperature of the preheated material and, after it has been set, it will continue to deliver uniformly preheated loads regardless of variations in moisture content, initial temperature, and density. The unit operates on 230- or 460-v., 60-cycle A.C., requiring 6.3 k.v.a. at 90% power factor. It is 21 in. wide by 24 in. deep by 53.8 in. high. *The Girdler Co., 224 East Broadway, Louisville 1, Ky.*

Pellet cooler and dryer

The Coolaire receives warm and/or damp pellets into a vertical column through which is blown air that cools and/or dries them. Through the concerted action of a vibrating take-off and level controller, the residence time of the pellets in the tower is accurately controlled. Fines are suspended in the rising air stream and trapped in a dust collector. The direct-driven, 1800-r.p.m. fan is powered by a 10 or 15-hp. motor. A ½-hp. motor drives the discharge vibrator. Any of four tower heights and various fan combinations may be had to meet specific processing needs. *Sprout, Waldron & Co., Muncy, Pa.*

Transfer leaf printer

Attaching directly to bag-making machines (Simplex and others), a new unit automatically dates, codes, etc., materials such as polyethylene, Pliofilm, cellophane, waxed paper, etc., that take hot roll leaf impression. It synchronizes with the bag-making machine, needs no operator, uses no

Table I: Characteristics of Amvac formers

Model	*Forming area*	*Heater power*	*Max. depth of draw*	*Length*	*Width*
	sq. ft.	*kw.*	*in.*	*ft.*	*ft.*
H-3	6	ca. 20	22	6	5
H-4	12	ca. 40	22	8	8
H-6	24	80	22	15	10
HR-6	24	80	17	24 (diam.)	

Thermex®
Plastic Preheater

The NEW 3RB holds temperature uniform

- ***SPEEDS UP HEATING***
- ***CUTS REJECTS***

Automatic load cycle control assures *uniform preform temperature*... load after load.

When set for a run, it automatically compensates for changes in moisture content, preform density, room temperature.

Permits higher preform temperature for faster production.

More uniform heating *cuts reject losses*, increases molding efficiency.

* Thermex—T. M. Reg. U. S. Pat. Off.

Full 3KW output of the Model 3RB can heat 9 oz. of general purpose preforms from 80°F to 250°F in 15 seconds!

Mail coupon for bulletin on this new 3KW THERMEX Preheater or call our nearest sales office.*

The GIRDLER Company

A DIVISION OF NATIONAL CYLINDER GAS COMPANY

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Sales Offices: 76 Beaver St., New York 5, N. Y. • 133 So. Clinton Avenue, Rochester 4, N. Y. • 505 Delaware Ave., Buffalo 2, N. Y. • 239 Newton Avenue, Newark, Ohio • 624 So. Michigan Avenue, Chicago 23, Illinois • 714 West Olympic Blvd., Los Angeles, Calif.

THE GIRDLER COMPANY
Thermex Division
224 E. Broadway, Louisville 1, Kentucky

Please send bulletin T95R4 on the New Model 3RB Preheater.

*Company Name*_____

*Company Address*_____

*City*_____ *Zone*____ *State*_____

*Your Name*_____

*Position*_____

Plastisol

Plastisols are versatile! Watson-Standard Laboratories formulate plastisols of specialized characteristics for a wide variety of end uses. They are adaptable to many methods of application.

Watson-Standard

PLASTISOLS MAY BE APPLIED BY:

Spraying	Spread Coating
Dipping	Roller-Coating
Casting	Troweling
Rotational Molding	Slush Molding

"Best Known Name In Plastisol"

W-S

Watson-Standard Co.

225 Galveston Ave., Pittsburgh 30, Pa.

NEW YORK OFFICE: 15 Park Row, New York 38, N. Y.
CHICAGO OFFICE: 55 E. Washington Street, Chicago 2, Ill.

PLASTICS • INDUSTRIAL FINISHES • CHEMICALS

ink, provides high-quality, permanent imprints. Brass or steel type has long life and can be changed easily. *The Industrial Marking Equipment Co., 454 Baltic St., Brooklyn 17, N. Y.*

Edger and trimmer for panels

Especially designed for trimming decorative laminates, the Model 1050 edger and trimmer uses either tungsten carbide cutters or saws, in pairs, to trim all four edges of sheets. When saws are used, they cut into the laminate surfaces from both sides, thereby producing smooth, unsplintered edges. There are four cutting motors of either 5 or 7.5 hp., and three 0.5-hp. Gearmotors for the conveyors; 220- or 440-v., 3-phase power is required. A blower system must be provided to collect the dust created in cutting. The machine handles sheets as small as 1 by 3 ft. and as large as 4 by 10 feet. Machines will be made to order for other size ranges. *Kvalheim Machinery Co., P.O. Box 77, Petaluma, Calif.*

Miniature potentiometer

The Dynamaster, a self-balancing electronic recorder which gives a continuous record on a 3-in. strip chart, is housed in a case only 5 in. square. It is offered in either potentiometer or AC-bridge models and can be used to measure any variable that can be converted into an electrical quantity, such as temperature, pressure, flow, etc. Both the indicating and recording chassis are plug-in units that can be interchanged in a few seconds. The instrument is said to have accuracy and sensitivity equal to those of a standard 12-in. instrument. *The Bristol Co., Waterbury 20, Conn.*

Forming and packaging machines

Three new Meteor models are combination drape- and vacuum-forming machines well suited to packaging work. The top side of the sheet is heated by rod-type heaters that are automatically timed. Maximum depth of draw is 15 in. on all models. The standard machine includes the heater with percentage-input controller, timer, clamp frame kit, drape

Specifications of meteor formers

Model	M-2030	M-3036	M-3660
Mold area (max.), in.	20 by 30	30 by 36	36 by 60
Sheet size (max.), in.	22 by 32	32 by 38	38 by 62
Height (oven lowered), in.	48	48	50
Weight, lb.	500	800	1600
Floor area, in.	42 by 55	47 by 81	72 by 82
Air at 80 p.s.i., cu. ft. per operation	0.5	0.5	1.0
Amperage	22.8	36	62
Electrical	220/1/60	220/3/60	220/3/60
Drape stroke, in.	15	15	15
Timer range, sec.	0-120	0-120	0-120
Vacuum pump, cu. ft./min.	9	9	18

mechanism with 720-lb. force, air regulator, and 9-c.f.m vacuum pump with tank and contactor. Characteristics of all three models are listed in the table. *Comet Industries, Franklin Park, Ill.*

Non-crazing mold release for polyethylene

Some cases of crazing and "environmental stress cracking" in polyethylene molding and film-fabricating operations have been traced to silicone oils in the parting agents used. A new neutral oil spray, developed expressly for polyethylene processing, contains no silicones. *Injection Molders Supply Co., 3514 Lee Rd., Cleveland 20, Ohio.*

Line of machinery for reinforced plastics molding

Roving cutters (including cutters for pre-impregnated rovings), preforming machines of several types, curing ovens, an automatic preforming and preform-curing machine, and two machines that make mat from roving are included in a new line of equipment designed for molders of reinforced plastics. The roving cutters are available in a range of widths, can cut in compression against a rubber roll or in tension through an open slot, and can cut at rates up to 1 lb./min. for each strand. Bundle integrity of fibers is maintained. The molding compound cutter draws the strands of roving through a resin tank, then cuts them to length. Preforming machines of four different designs are available in a number of size ranges. All have automatic cycle timing, roving cutters, spray guns, and fiber distributors. The rotary type, the largest, will produce up to 120 preforms per hour. The mat-forming machine offers the large-volume user a number of advantages over purchased mat: better control of quality, choice of width and density, including variation of density across mat if desired, convenience, and economy. The two standard sizes make mat in widths ranging from 24 to 51 in., and from 40 to 76 in., respectively, with a uniformity of ± 5 percent in the areal density. *I. G. Brenner Co., 32 East North St., Newark, Ohio.*

Laminate preheater and feeder

Laminated plastic and fiber strip stock is automatically fed by a new unit into any standard blanking press at controlled temperatures up to 300° F. Positive butting of the ends of successive strips reduces partial blanking of pieces to a minimum. A single loading of the magazine can produce up to a day's run, and one attendant can service a battery of presses with these feeders. Height of feed is adjustable to level of press die. *Technical Design and Development Co., Inc., Milford (Devon), Conn.*

MARKED IMPROVEMENTS in

IDENTIFICATION AND DECORATION

A voice from the shelf . . . *that says "Here's the paint . . . drug . . . oil . . . you're looking for . . ." would certainly help both buyer and seller. Attractively lithographed cans do "talk" this way, but one trouble has been high production runs of lithographed cans vs. the short run needs of variables such as color names, batch numbers and date codes. Markem suggested imprinting the variables on partially lithographed cans, as they are needed, and built the 70AF machine to do the job. Today a fair number are in use, imprinting little 1/32 to full gallon sizes, areas to 2" x 6", at rates up to 1500 an hour (an even faster rotary machine is underway). Beats torn, smudged or missing paper labels all hollow.*

"Elephant trunk" marker . . . *is not the usual way Markem describes its machines, but for the 89A, the nickname has stuck. This is a typical Markem "Special Products" development, for marking tradename and size on tubular rubber insulation. The inelegant nickname originated because the material is a six foot length of gray tube 1¼" to 5" in diameter. It is fed into the machine, passes under the printing head and ejected by a lower drive roll. Adjustments for different diameters are easily made, and other useful features include mobility for use in different locations, variable speed motor, excellent imprint quality with Markem's jasmine yellow marking compound. The people who worked out this "Special" perhaps can help you, if you have a yet-unanswered problem in identification/decoration marking.*

"Do-it yourself" . . . *is often prompted by economy reasons. In marking products, however, the manufacturer who "does it himself" not only saves money, but also gets what he wants when he wants it. Here's what we mean: a company making plastic cases for eyeglass lens cleaner had the product name and directions imprinted on the containers by a job printer. The method was neither convenient or economical. The local Markem man presented a case for the 20A machine, and it gave a good account of itself in an 80-prints-per-minute run. Having another satisfied customer makes us happy, and he's tickled with the quality, convenience, and prospect of the 20A paying for itself in six months.*

Is there a shape, surface or size giving you trouble in efficient marking? Try the Markem Method — a source of better marking for 46 years. Write Markem Machine Co., Keene 20, N.H.

MARKEM

Books & Booklets

Write for these publications to the companies listed. Unless otherwise specified, they will be sent gratis to executives who request them on business stationery.

"British Plastics Yearbook, 1957"

Published in 1957 by Iliffe & Sons, Ltd., Dorset House, Stamford St., London, S. E. 1, England. 716 pages. Price: 42s (ca. $6.00).

This guide to the British plastics industry, 27th edition, thoroughly revised, is divided into nine sections. Three are devoted to classified lists of manufacturers and suppliers of materials, finished products, and equipment. Another section contains a list of trade and proprietary names connected with the industry, and includes a glossary of technical terms. Still another section lists the names and addresses of almost 4000 firms associated with plastics, grouped into countries. The "Who's Who" section lists names and positions of prominent people actively engaged in the industry in Great Britain. The annual review of plastics patents contains over 140 pages on relevant patents issued last year. This same section includes a list of the new plastics companies registered in 1956, and also the British Standard Specifications relating to the industry.

Epoxide adhesives. Brochure describes complete line of Eccobond epoxide adhesives, cements and conductive cements, and sealants, which are available as low-viscosity liquids, non-flowing pastes, and one component powders. 8 pages. *Emerson & Cuming, Inc., 869 Washington St., Canton, Mass.*

Special tooling services. Up-to-date "Directory of Special Tooling Services" offered by NTDMA members lists approximately 1000 contract tool and die plants throughout the U. S. together with addresses and telephone numbers, names of individuals to contact, and specific products and services offered by each association member. 68 pages. *National Tool & Die Manufacturers Assn., 907 Public Sq. Bldg., Cleveland 13, Ohio.*

Heating cylinder accessories. Handbook correlates, lists, and discusses features of heater bands offered to the injection molder. Space is provided for the molder to list bands of his own sizes to fit other heating cylinders as they are ordered. 20 pages. *Injection Molders Supply Co., 3514 Lee Rd., Cleveland 20, Ohio.*

Coatings chart. The Universal Pro-Coat Chart lists almost every structure, article, or surface in the architectural, industrial, and marine fields, and recommends liquid plastic coatings to meet just about every known condition. Supplemented by an additional chart setting forth comparative performances of individual plastic coatings under a variety of conditions, application methods, costs, and other pertinent data, the combined use of these charts is calculated to simplify the selection of the proper plastic coating from the entire field of protective coatings currently offered by the company. Price $1.00. *Protective Coatings, Inc., 807 N. Fremont Ave., Tampa, Fla.*

Butyrate plastic pipe. Bulletin reprints a discussion of the composition, properties, and applications of butyrate plastic pipe, based on a paper presented at the 12th National Technical Conference, S.P.E., at Cleveland, Ohio. Included are descriptions of the chemical composition of butyrate molding materials; the physical and chemical properties of Tenite butyrate plastic for pipe; creep test data on pipe extruded from Tenite butyrate; fittings, fabrication, and installation techniques; and successful industrial applications. 8 pages. *Eastman Chemical Products, Inc., Kingsport, Tenn.*

Resin-rubber compounds. Bulletin No. 1 explains the extrusion of Kralastic, a blend of plastic and rubber. It describes equipment needed, production processes, and properties, and presents graphs detailing its performance as a pipe material. 16 pages. *Kralastic Sales Dept., Naugatuck Chemical Div., United States Rubber Co., Naugatuck, Conn.*

Packing and shipping operations. A number of specific suggestions that can be put to immediate use are included in "How to Save Labor Costs with Corrugated Boxes." The booklet, offering many new ideas regarding the use of intelligently designed corrugated boxes, provides a sound yardstick for measuring packing costs. 26 pages. *Hinde & Dauch, Sandusky, Ohio.*

Plastics reference file. A revised edition of the "Condensed Reference File of Bakelite Plastics" gives distinguishing characteristics, appropriate fabricating techniques, and major fields of application for polyethylenes, vinyls, phenolics, styrenes, epoxies, and polyesters supplied by the company for industrial use. More than 80 photographs and sketches illustrate some typical uses of these materials. 16 pages. *Bakelite Co., a Div. of Union Carbide and Carbon Corp., 30 E. 42nd St., New York 17, N. Y.*

Bag molding. Technical bulletin on Fairprene synthetic elastomer curing bag and blanket materials describes and illustrates five methods of bag and blanket molding. Included is an illustrated section on the technique of laying out, cutting, and cementing the molding bag. 8 pages. *E. I. du Pont de Nemours & Co., Wilmington, Del.*

Silicone products. Almost 150 commercially available silicone products are described in this new, illustrated catalog. Descrip-

VERSATILE- *Fast Curing . .*

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PHENOLIC MOLDING COMPOUNDS BY

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Batch to batch, INDUR Powders are *top quality*, controlled by Pitt-Consol's up-to-the-minute analytical methods and instruments . . . Specify INDUR Phenolic Molding Compounds—the key to consistent quality and increased production.

Count on Pitt-Consol too, for technical assistance on any problem you may have in the use of phenolic resin and molding compounds. Inquiries are also invited for special formulation and color requirements.

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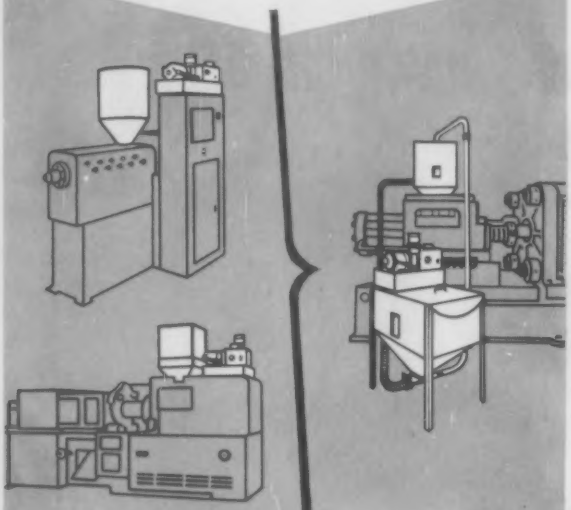
Automatic Jet HOPPER LOADER



. . . Gives you these features:

1. More production, lower costs, higher products quality.
2. Easily adapted to any standard injection or extrusion machine.
3. Loads and dries automatically *without use of compressed air.*
4. Saves labor and floor space by eliminating drying ovens.
5. Compact—mounts on machine, on wall, or can be portable.

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We pay top prices for all types of plastics scrap and surplus virgin materials. Turn yours into cash.

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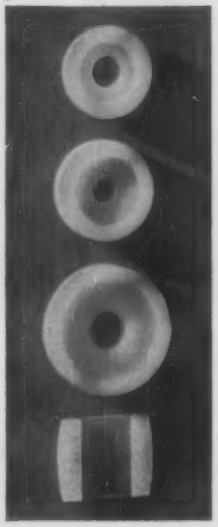
Processors of Plastics Materials

NYLON PLASTIC *reduces kitchen noise!*



Sinko Produces Nylon Parts That Give Years of Economical, Trouble-Free Service

Pictured are 3 Sinko Nylon cabinet rollers and a drawer skid-block that are being used successfully by several leading manufacturers of fine kitchen equipment. Sinko Nylon was selected after a series of exhaustive tests had proven its superiority in every respect. In one experiment a small drawer equipped with Sinko Nylon rollers was loaded and automatically operated the equivalent of a normal 200 years service. Upon examination the Sinko Nylon rollers showed little sign of wear.

You too should investigate the many advantages Sinko Nylon offers, among them—resistance to wear and to shock loads, to moisture, chemicals and to temperature; and its smooth-gliding, self-lubricating properties.

SINKO MOLDS ALL THERMOPLASTICS FROM 4 TO 100 OZ

SINKO MANUFACTURING & TOOL CO.

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tions are brief and factual, with emphasis on charts, tables, and graphs directly comparing various silicones with the materials they are displacing. 12 pages. *Dow Corning Corp., Midland, Mich.*

Epoxy curing agents. Technical Bulletin F-8665 describes diethylene triamine, triethylene tetramine, dimethylamino propylamine, diethylamino propylamine, and alpha-methylbenzyl dimethylamine, epoxy resin curing agents that provide formulators with a range of working times extending from a few minutes to an hour or more. 8 pages. *Carbide and Carbon Chemicals Co., a Div. of Union Carbide and Carbon Corp., 30 E. 42nd St., New York 17, N. Y.*

Resins for shell molding. The shell molding process for casting metals, with particular emphasis on the foundryman's problems, is described and illustrated in "Plaskon Resins for Shell Molding." Included are design and production considerations such as cost. 32 pages. *Barrett Div., Allied Chemical & Dye Corp., 40 Rector St., New York 6, N. Y.*

Polyethylene pipe. Folder discusses the resistance to environmental stress cracking and to weathering of Tenite polyethylene cold water pipe, used for conveying water in many farm, home municipal, and industrial uses. *Eastman Chemical Products, Inc., 260 Madison Ave., New York 16, N. Y.*

"Dust Control for Industry." Bulletin No. 922, encompassing a complete range of dust control equipment and accessories, describes the importance of dust control to industry in relation to reduced maintenance costs, employee morale, and commercial utilization of dust by-products. 16 pages. *Pangborn Corp., Hagerstown, Md.*

Safety data sheets. Properties and essential information for the safe handling and storage of mixed acids are given in a new safety data sheet, SD-65, 16 pages. Revised data sheets are available on: trichloroethylene, SD-14, 16 pages; ethyl ether, CD-29, 19

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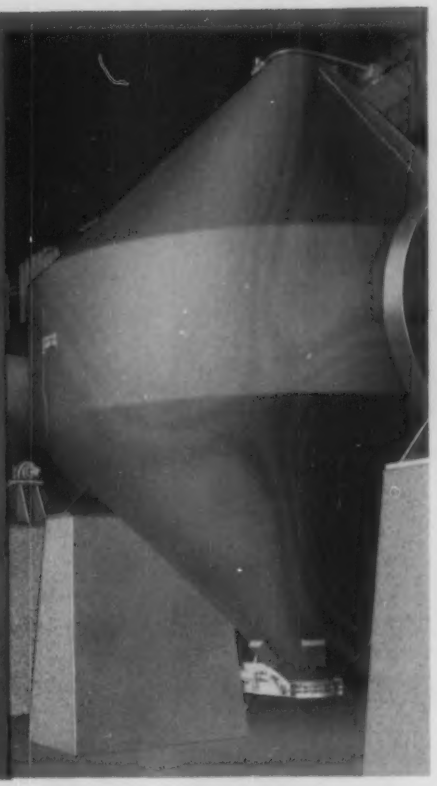

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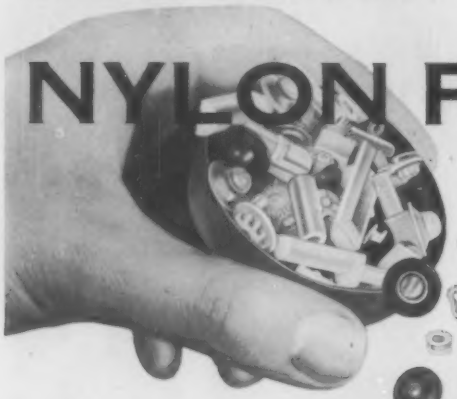

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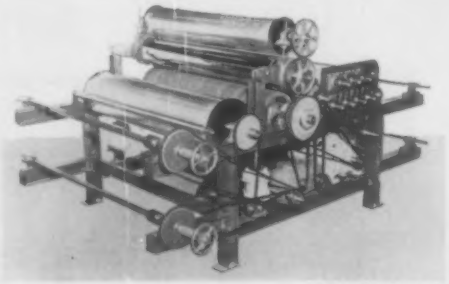

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pages; and phthalic anhydride (commercial), SD-61, 16 pages. 30¢ each. *Manufacturing Chemists' Association, Inc., 1625 Eye St., N.W., Washington 6, D. C.*

Nylon resin. Price List SN-1 gives characteristics, form of processing, and general applications for eight grades of the company's nylon. 4 pages. *Spencer Chemical Co., Dwight Building, Kansas City 5, Mo.*

Ethylene oxide. Illustrated technical manual gives latest information on analytical procedures, physical and chemical properties, and industrial uses of ethylene oxide. Data on handling techniques, toxicity, and specifications on commercial grades are included. Bibliography lists almost 500 references. 42 pages. *Jefferson Chemical Co., Inc., P.O. Box 303, Houston 1, Texas.*

Polymerizers. Bulletin No. 932 outlines and illustrates latest advances in glassed-steel polymerizers. 8 pages. *The Pfaudler Co., 1024 West Ave., Rochester, N.Y.*

Dielectric ovens and heaters. Bulletin 56-E describes and illustrates standard dielectric ovens and heaters and gives their dimensions and power output ratings. 4 pages. *Young Brothers Co., Dept. D-16, 1831 Columbus, Cleveland 13, Ohio.*

"Proved by Performance" discusses the economical and reliable service provided by pipe made from polyethylene. Specifications for safe working pressures, adopted by the pipe industry, are also included. 8 pages. *Bakelite Co., a Div. of Union Carbide and Carbon Corp., 30 E. 42nd St., New York 17, N.Y.*

Teflon. Bulletin T-100 details the application of Teflon as a liner for steel pipe. 2 pages. *Halocarbon Div., Haveg Industries, Inc., 900 Greenback Rd., Wilmington 8, Del.*

Electrical tools. Catalog No. 104 gives complete specifications for electric saws, sanders, drills, planes, routers, shapers, combination tools, and others used

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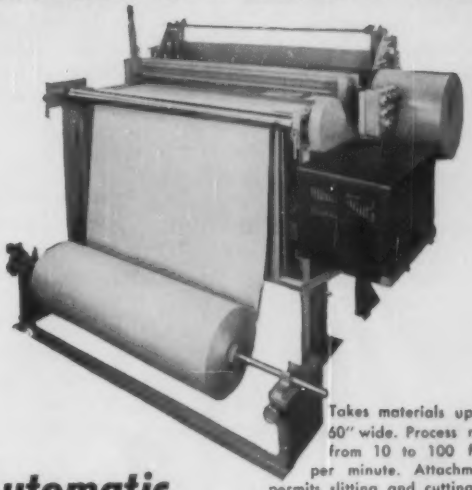

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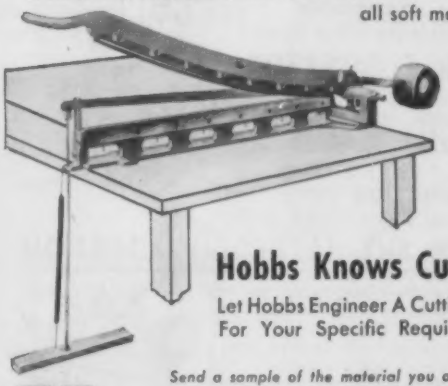

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by the plastics industry. 32 pages. *Porter-Cable Machine Co., 93 Exchange Street, Syracuse 8, N.Y.*

Special products. Bulletin No. 100 describes the facilities of the company's Special Products Div. for casting, potting, low pressure molding, dipping, and electronic assembly. Also shown are a number of new products currently being produced by these methods. 4 pages. *Boonton Molding Co., Boonton, N.J.*

Valves and fittings. Illustrated booklet gives specifications, service conditions, and applications of rigid polyvinyl chloride valves and fittings. *Walworth Co., Inc., 60 East 42nd Street, New York 17, N.Y.*

Polyester-glass laminates. Folder contains data chart on physical and electrical properties of Glastic polyester-glass laminate electrical insulation. Listed are rigid and flexible laminates, with common phenolic properties given for comparison. 4 pages. *The Glastic Corp., 4321 Glenridge Rd., Cleveland 21, Ohio.*

Product line. A listing and brief description of the company's line of chemical products, together with important uses, basic physical properties, and other pertinent data is given in a new products book. 56 pages. *Solvay Process Div., Allied Chemical & Dye Corp., 61 Broadway, New York 6, N.Y.*

Ink system. Bulletin No. 411 gives outstanding characteristics, recommendations for use, and prices for the "MY" complete ink system for gravure printing on Du Pont's Mylar polyester film. 2 pages. *Claremont Pigment Dispersion Corp., 39 Powerhouse Rd., Roslyn Heights, Long Island, N.Y.*

Plastic pipe. Booklet gives the results of "A Study of Plastic Pipe for Potable Water Supplies" in which 22 samples of plastics pipe extruded from polyethylene, polyvinyl chloride (including saran), rubber-modified polystyrene, and cellulose acetate butyrated were tested. 91 pages. Price: $1.00. *National Sanitation Foundation, School of Public Health, University of Michigan, Ann Arbor, Mich.*

Production facilities. Illustrated booklet describes facilities and services offered to the plastics producer in the fields of design, engineering, research, development, mold-making (compression, injection, reinforced plastics), molding, finishing, secondary machining, and assembly. 15 pages. *Molded Products, Div. of Admiral Corp., Washington Ave. at Creamery Rd., P.O. Box 338, West Chicago, Ill.*

"All Holes Barred," a 20-min. color and sound movie, shows the correct application of Scotchrap vinyl pipe insulating tape for corrosion prevention. Step-by-step sequences demonstrate proved methods of insulating couplings, street *T* fittings, weld joints and

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Silicone rubber. Data sheet and compounding study gives detailed information and instructions to manufacturers, fabricators, and product designers on the use of W-96 vinyl-containing methyl silicone gum stock. 28 pages. *Silicones Div., Union Carbide and Carbon Corp., 30 E. 42nd St., New York 17, N.Y.*

Paste colors. Bulletin Sheet No. 02-160-0-9-56 gives color composition and specific gravities for line of Stan-Tone PEC polyester paste colors made of selected pigments completely dispersed in a polyester vehicle. *Harwick Standard Chemical Co., 60 S. Seiberling St., Akron 5, Ohio.*

Glass cloth. Folder contains a technical data sheet on Stanpreg flame-resistant epoxy resin-pre-impregnated glass cloth, and an 8½- by 11-in. sample sheet of the cloth. The technical data sheet gives the physical, electrical, and general properties of the material. *Standard Insulation Co., 74 Paterson Ave., E. Rutherford, N. J.*

Foam polyethylene. Data sheet gives properties, A.S.T.M. test methods, and variations of properties with increasing density for Agilene-F expanded polyethylene, available in extruded form or molded to specification. *American Agile Corp., P.O. Box 168, Bedford, Ohio.*

Panel saws. Folder gives specifications, descriptions, and illustrations of the manually operated model MLR, and the manual and automatic model MA panel saws for use by plastics fabricators. Both models are available in maximum capacities from 4½ to 12½ feet. *Hendrick Mfg. Corp., 11 Selman St., Marblehead, Mass.*

Radiant heater mats. Data sheet discusses industrial radiant heating mats, available in widths of 12 to 42 in. and any length suitable to voltage and phase. The mats, which are supplied equipped with 1-ft. leads, are flexible and

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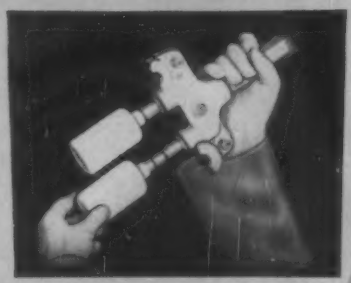

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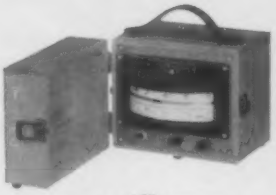

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can be applied to flat or curved surfaces where heat is needed over a wide area. *Zack Industries, 185 Goffle Rd., Hawthorne, N.J.*

Pipe, fittings, valves. Catalog P101 gives technical and descriptive data on pipe, fittings, and valves made of PVC, styrene-copolymer, and Buna N. 8 pages. *Vanton Pump & Equipment Corp., 201 Sweetland Ave., Hillside, N. J.*

"Plastics as Building Materials," Index No. D9.0, explains the two types of plastics—thermoplastics and thermosets—and gives the characteristics, comparative heat resistance, and strength data for seven families of plastics commonly used for building products. 8 pages. *Small Homes Council, University of Illinois, Urbana-Champaign, Ill.*

Industrial cooling and heating. Booklet entitled "For Your Industry" gives full technical details and mechanical specifications on cooling and heating equipment. *Vic Mfg. Co., 1313 Hawthorne Ave., Minneapolis 3, Minn.*

Casting with epoxy resin compounds. Technical Bulletin No. 10, while discussing specifically Metalset and Sonite epoxies, gives information that applies to the handling of all epoxy casting compounds. 4 pages. *Smooth-On Mfg. Co., 572 Communipaw Ave., Jersey City 4, N. J.*

Chemicals. Bulletin lists over 200 fine chemicals, intermediates, and industrial chemicals for the plastics, dyestuff, textile, paint, electroplating, metals, rubber, drug, paper, chemical, and agricultural industries. 4 pages. *Aceto Chemical Co., 40-40 Lawrence St., Flushing 54, N.Y.*

Reinforced plastics. Color film, "Designing with Reinforced Plastics," developed by the Reinforced Plastics Div. of S.P.I., explores the physical and economic reasons for today's growing acceptance of these materials in many industries. The 74-frame 35-mm. film, two copies of its script, and an "S.P.I. Speakers' Manual" containing tips on effective program

U.S.I.

Vol. II, No. 3

POLYETHYLENE PROCESSING TIPS

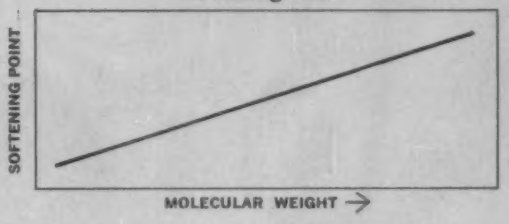
HOW MOLECULAR WEIGHT AFFECTS POLYETHYLENE PROPERTIES

Molecular weight is one of the three most important resin characteristics that determine end-use properties of polyethylene. *Density* and *molecular weight distribution* are two others.

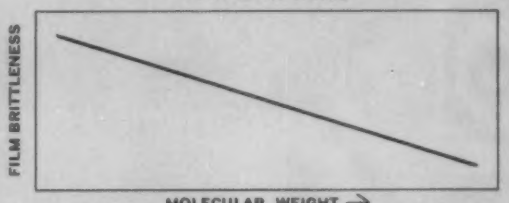
Melt Index is an approximate measure of molecular weight. Resins with low molecular weight have high melt index values, and vice versa.

The following graphs show the effect of increasing molecular weight, (or decreasing melt index) assuming that density and molecular weight distribution remain constant. In practice, of course, these characteristics are different for different resins so the effects of all three must be considered.

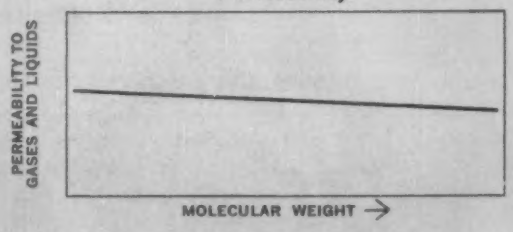
Softening Point



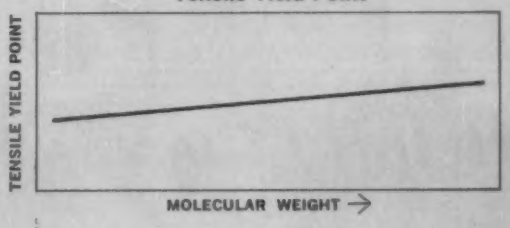
Film Brittleness



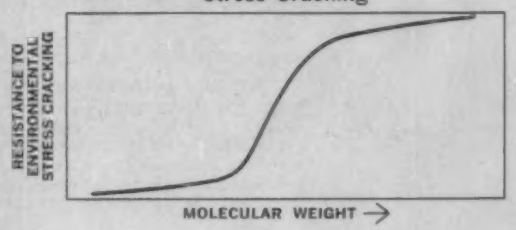
Permeability



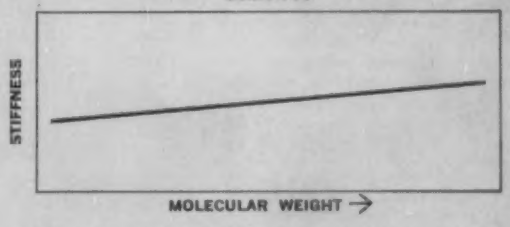
Tensile Yield Point



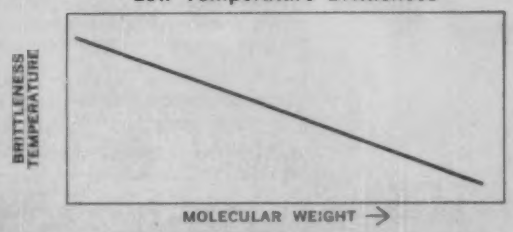
Resistance to Environmental Stress Cracking



Stiffness



Low Temperature Brittleness



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PLASTICIZERS FOR VINYL RESINS. Folder describes two high molecular weight polyesters recommended for all types of vinyl compounding. Includes physical properties and performance data. Archer-Daniels-Midland Company. **(E-713)**

ASBESTOS FIBRES FOR REINFORCED MOLDING COMPOUNDS. Technical bulletin describes advantages and characteristics of company's asbestos fibres for use in reinforcing polyester molding compounds. Asbestos Div., World Commerce Corp. **(E-734)**

POLYETHYLENE HANDBOOK. 26-page illustrated handbook discusses company's "Marlex 50" polyethylene. Includes charts and graphs of properties and characteristics. Discusses typical applications. Phillips Chemical Co. **(E-735)**

CARBIDE-TIPPED SAW BLADES. Illustrated folder describes, gives specifications, and provides prices for line of "Thin-rim" carbide-tipped blades for cutting plastics materials. DeLuxe Saw & Tool Co. **(E-736)**

Any of the booklets described here, plus many others—forty-four in all—are available for the asking, without charge or obligation.

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VINYL AND POLYETHYLENE SHEET. Literature contains price schedules for company's rigid vinyl sheets, and sheets molded from virgin polyethylene. United Laminations, Inc. **(E-737)**

SPRAY PAINTING MASKS. Illustrated folder describes electroformed metal masks for multi-color spray decoration of plastics surfaces. Illustrates use of different mask types, including types for special applications. Conforming Matrix Corporation. **(E-739)**

ELECTRIC RADIANT HEATERS. Folder illustrates, describes, and gives specifications for fused quartz electric radiant heaters available in single or multiple units, panels, or complete oven assemblies. Cleveland Process Co. **(E-740)**

TRANSPARENT SHEETING. Bulletin describes "Seilon DP," available in flat or corrugated rigid transparent sheets up to ¾" thick for use as windows, partitions, and display. Lists stock sizes available, gives physical and chemical properties. Seiberling Rubber Co. **(E-741)**

presentation are priced at $15. *The Society of the Plastics Industry, Inc., 250 Park Ave., New York 17, N. Y.*

Plasticizers. Methods of preparation and individual properties of several epoxy fatty acid ester plasticizers are described in Technical Bulletin No. 80. 3 pages. *Becco Chemical Div., Food Machinery and Chemical Corp., Station B, Buffalo, N. Y.*

Methallyl chloride. Technical Bulletin No. 1 gives a comprehensive review of methallyl chloride chemistry, along with suggested applications and an extensive bibliography. 23 pages. *FMC Organic Chemicals Div., Food Machinery and Chemical Corp., 161 E. 42nd St., New York 17, N. Y.*

Corrections: Resins for reinforced plastics

Three errors have been called to our attention in the article "What's happening in resins for reinforced plastics?" MODERN PLASTICS 34, (Feb. 1957).

On p. 86, starting on line 16, is a statement that postcuring of Plaskon laminating varnish V-204 requires high pressure. According to Barrett Div., Allied Chemical and Dye Corp., high pressure is not necessary and the statement should read as follows: "Barrett recommends for ultimate quality of laminate a 16- to 18-hr. postcure at 350 to 360° F., followed by a gradual temperature increase of 15° F./hr. from 350 to 600° F. for Plaskon laminating varnish V-204."

On p. 213, column 1, starting on line 15, is the following statement: "The prepolymer is also pre-shrunk, with approximately 11% contraction remaining." The prepolymer referred to is a product of Ohio-Apex, which company has made the following statement: "The amount of shrinkage remaining in Dapon resin which can take place during final cure is less than 1%. The total shrinkage taking place when diallyl phthalate monomer is fully cured is 11 to 12%."

On p. 219, column 3, line 9, the temperature given should be 450° F. instead of 45° F.

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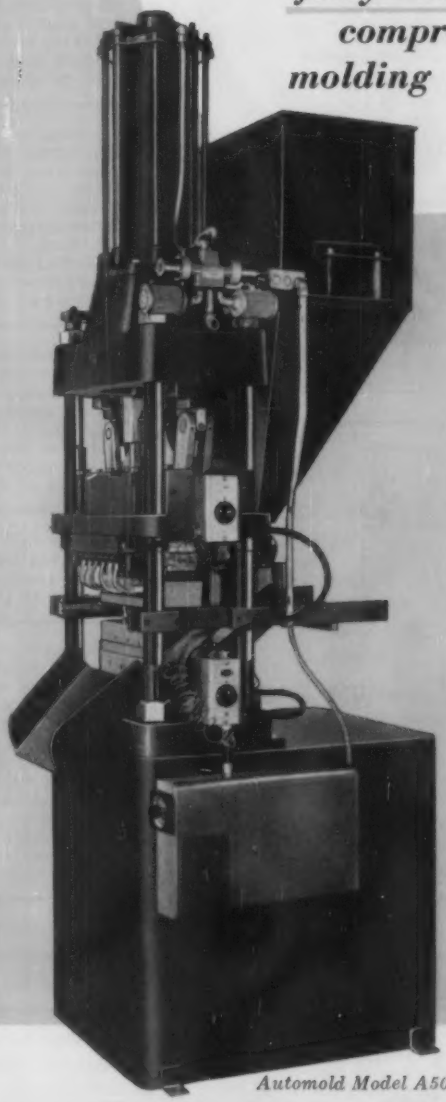

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5/8"	V						
3/4"	V	V	V	V	V	V	V
7/8"	V			V		V	
1"	V	V	V	V	V	V	
1 1/8"	V	V		V	V	V	
1 3/4"	V			V			
1 1/8"		V		V		V	
1 3/8"	V			V			
1 1/2"	V						
1 3/4"	V						
2"	V						

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Materials
Cellulose plastics:[a]
Cellulose acetate and mixed ester:
Sheet, under 0.003 gage
Sheet, 0.003 gage and over
All other sheets, rods, and tubes
Molding and extrusion materials
Nitrocellulose sheets, rods, and tubes
Other cellulose plastics
Phenolic and other tar-acid resins:
Molding materials[a]
Bonding and adhesive resins for:
Laminating (except plywood)
Coated and bonded abrasives
Thermal insulation
Plywood
All other bonding uses¶
Protective coating resins
Resins for all other uses
Urea and melamine resins:
Textile-treating resins
Paper-treating resins
Bonding and adhesive resins for:
Plywood
All other bonding and adhesive uses, including laminating
Protective-coating resins
Resins for all other uses, including molding
Styrene Resins:
Molding materials[a]
Protective-coating resins
Resins for all other uses
Vinyl resins, total[b]
Polyvinyl chloride and copolymer resins (50% or more polyvinyl chloride) for:
Film (resin content)
Sheeting (resin content)
Molding and extrusion (resin content)
Textile and paper treating and coating (resin content)[c]
Flooring (resin content)
Protective coatings (resin content)
All other uses (resin content)
All other vinyl resins for:
Adhesives (resin content)
All other uses (resin content)
Coumarone-indene and petroleum copolymer resins
Polyester resins
Polyethylene resins
Miscellaneous:
Molding materials[a, d]
Protective-coating resins[e]
Resins for all other uses[f]

*Dry basis designated unless otherwise specified. †Revised. ‡Partially estimated. ¶Includes friction materials. [a]Includes fillers, plasticizers, and extenders. [b]Production statistics by uses are not representative, as end use may not be known at the time of manufacture. Therefore, only statistics on total production

Production

From statistics compiled by the U. S. Tariff Commission

Preliminary total, 1956†		*January 1957‡*	
Production	*Sales*	*Production*	*Sales*
19,384	19,627	1,440	1,310
16,656	16,533	1,438	1,218
7,282	7,049	612	514
92,745	91,721	7,456	7,001
5,254	4,835	377	489
5,651	5,159	525	308
214,729	190,457	17,559	16,675
62,832	44,365	5,212	4,139
15,644	16,506	1,692	1,670
56,151	55,129	4,459	4,242
44,187	35,613	3,756	2,835
49,789	47,637	4,914	4,416
29,503	25,763	2,710	2,415
39,455	34,276	3,782	3,267
40,784	38,896	3,398	3,461
24,775	23,277	2,546	2,319
102,081	95,361	7,338	7,257
25,205	23,878	2,158	2,275
37,250	27,817	3,488	2,631
87,167	84,478	7,657	7,875
433,037	389,384	32,296	36,093
91,135	87,387	7,429	6,901
104,416	104,973	11,211	9,875
752,410	717,592	67,096	64,725
	78,064		8,094
	52,505		5,761
	203,812		18,805
	62,931		6,197
	65,500		5,958
	28,522		3,077
	74,621		3,438
	36,563		2,988
	115,075		10,408
245,586	241,846	17,644	18,432
72,588	65,292	7,265	6,444
556,919	509,399	52,357	53,188
43,542	40,713	4,655	4,542
11,448	5,723	1,170	483
117,894	109,312	10,175	10,313

are given. [c]Includes data for spreader and calendering-type resins. [d]Includes data for acrylic, nylon, and other molding materials. [e]Includes data for epichlorohydrin, acrylic, silicone, and other protective-coating resins. [f]Includes data for acrylic, rosin modifications, nylon, silicone, and other plastics and resins for miscellaneous uses.

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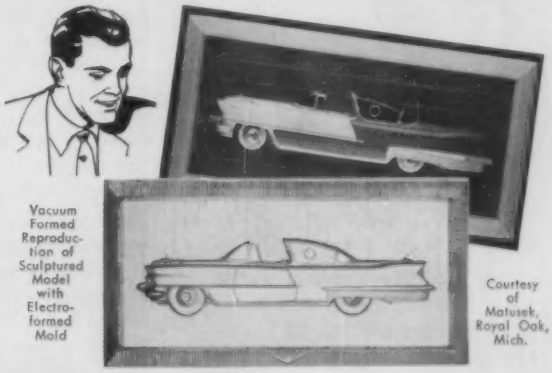

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Where readers may voice their opinions on any phase of or problem in the plastics industries, controversial or otherwise. The editors of MODERN PLASTICS take no responsibility for opinions expressed in letters herein.

The Editor, MODERN PLASTICS:

The technical leadership of the Society of Plastics Engineers was self-evident in the excellent 13th annual conference recently concluded in St. Louis. The quality of the papers presented on a broad range of subjects was high. Lecture rooms were crowded to capacity. Questioning was brisk and constructive.

An examination of the program shows nearly 60% of the papers were presented by men affiliated with plastics material suppliers. This fact allows room for criticism since our society is an organization of individual engineers from all branches of the industry. We need more universal participation in technical activities to serve the interests of all members better and to provide recognition for scientific and practical advances made by the "silent segments" of the industry.

It isn't difficult to write a good paper. It may be just as difficult to write a poor one. Presentation of a well-executed paper offers advancement in the professional reputation of the author. His employer will realize this. What boss can resist boasting to his associates: "I have a boy from my engineering department giving a paper at the S.P.E. national meeting in Detroit in January." Or telling his customers: "Of course, our engineering department is highly rated. Several of our men have given talks at the S.P.E. annual technical meetings and they are well respected in the industry." Or resist handing a prospective customer a reprint of the technical paper to prove the solid quality of his organization? This is not speculation—it happens in the plastics material supply business all the time.

Some folks like to keep their developments secret. Patents and trade secrets have helped American industry tremendously, but trade secrets have a way of quickly becoming common knowledge. Often it is a good idea to receive credit for a discovery before it has been kicked around so much no one can recognize it.

It is a well-known fact our own ideas often can be augmented by discussion with others. Who has not come out of such a session without finding that the discussion has improved the ideas he took into it?

One of the greatest advantages an engineer can derive from writing a technical paper is a much better understanding of his own knowledge. Half-baked ideas are quickly seen in their true dimensions and must be discarded when considered coldly for acceptance in print. Half-understood ideas must be reduced to complete and simple statements with the surprising effect of making the author more sure of his conclusions. Unnoticed ideas appear to an author when he sets out to organize his story and then contemplates what he has organized.

All of this sounds very inspiring but human nature was born loaded with the inaction which makes us all rather resistant to inspiration.

January 1958 is only a month away, as far as decisions on presenting papers are concerned. Notices are in the mail to all S.P.E. members requesting papers and suggestions for the 1958 meeting. (Non-members' contributions are also welcome—Ed.)

A few of many topics which need discussion are offered to stimulate further thought on the part of S.P.E. members. As a

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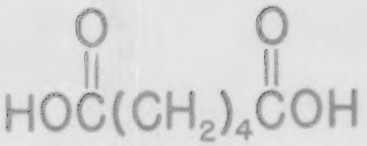

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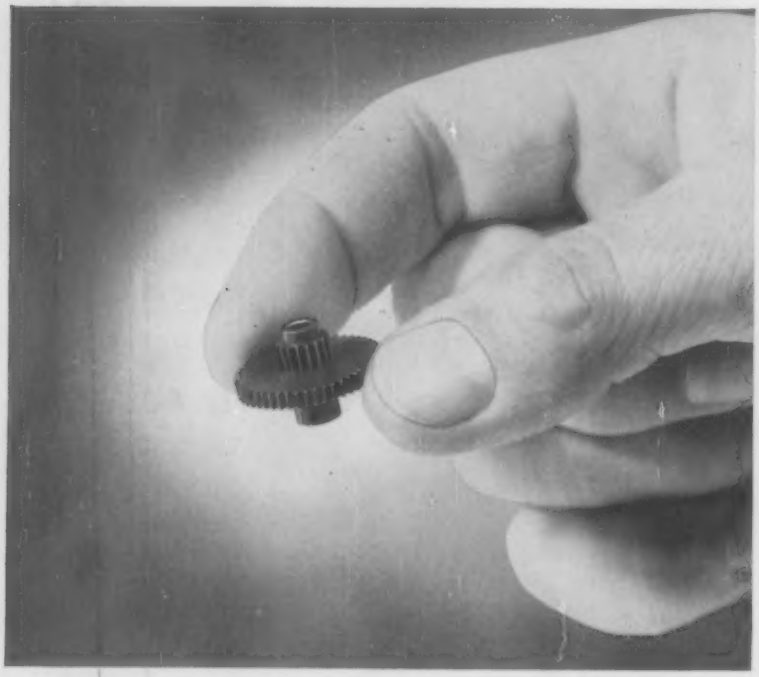

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"starter," a few topics are: novel applications of plastics, automation, maintenance, plant layout, materials handling, testing of finished products, and in-plant training of plastics engineers.

The 1958 annual technical conference will be as good as the participation of plastics engineers make it. The Speakers Committee will do its part in arranging the mechanics of presentation if the engineers will provide the technological material.

W. C. Goggin, chairman,
Speakers Committee,
S.P.E. 1958 Annual Technical Conference

The Editor, MODERN PLASTICS:

Interest in the 1957 Conference of the Reinforced Plastics Div. of S.P.I. was unusually high. While the meeting is still fresh in our minds, it may be an ideal time for those who plan to attend and participate in the 1958 Conference to let the Program Committee know at this early date where their interest lies.

Although the Program Committee is composed of men from many facets of the reinforced plastics industry, it is possible that a program may be developed that will contain subjects of limited interest to the majority of those who attend the meeting.

The Committee is anxious to develop a program of the widest possible interest. A better variety of subjects can be presented and the scope of the papers be more accurately pinpointed if the readers of this column will suggest subjects or titles of papers of particular interest. If you have a project that you feel may be of interest to the industry, the writer would be most happy to know of it. It has been suggested that less emphasis be placed on highly technical subjects and more added to the interests of industrial designers and management.

Let the Committee know your preferences, and you can be assured that the 13th Conference will hold a high degree of interest. Send your letters to the writer.

George L. Smead, manager,
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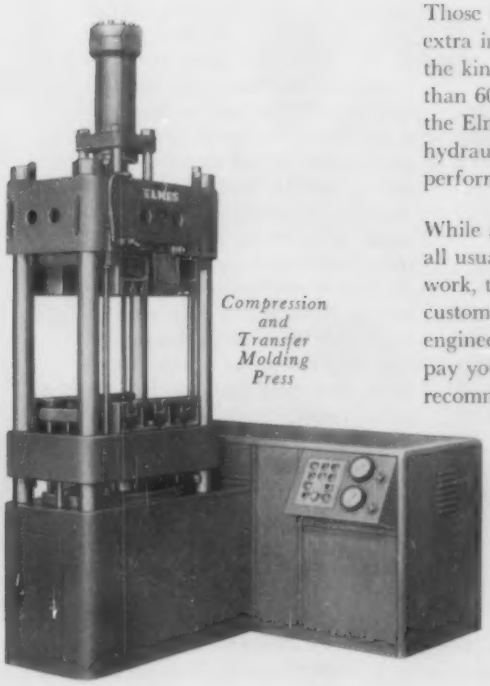

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Progress report

(From pp. 107-111)

ford, Conn., with its recent acquisition of Vacuum Forming Corp., can offer a diversified line that takes in trapped-sheet forming, straight and drape forming, plug-assist, and a combination integral forming-trimming operation. Similar diversification will probably come from other manufacturers. These include: Abbott Plastic Machine Corp., Chicago, Ill.; Atlas Vacuum Corp., Rochester, N.Y.; Borkland Mfg. Co., Marion, Ind.; Comet Industries, Franklin Park, Ill.; Hydro-Chemie, Zurich, Switzerland; Kal Plastics, Beaverton, Mich.; Plaxall Corp., Long Island City, N.Y.; Robbins Tool & Die Co., Elkhart, Ind.; Syracuse Plastic Molders, Syracuse, N.Y.; Tamco Industries, Huntington, N.Y.; Thermomat, Trenton, N.J.; Welding Engineers, Norristown, Pa.; and Zack Industries, Hawthorne, N.J.

Most of the machines supplied by these manufacturers provide one or more basic forming processes: straight vacuum forming, drape forming, pressure forming (with matched metal molds, plug-and-ring, or air pressure), and plug-assist forming. The first three techniques are familiar to the sheet forming industry; the fourth is new but has already had considerable acceptance. In plug-assist forming, the plug, which approximates the shape of the cavity, forces the sheet down into the mold. When the plug enters the cavity, the air pressure under the sheet increases, causing the softened sheet to blow upwards away from the mold edges and to press closely around the plug. When properly controlled, this billowing action prevents the sheet from dragging on the edges of the mold cavity and allows more of the horizontal material to be drawn uniformly into the cavity. When the plug has nearly reached the bottom of the mold, the vacuum is pulled and the sheet is formed in the mold.

Another new technique which has aroused interest is that of "air-slip" forming, developed by Hydro-Chemie and available in this country on Hydro-Chemie's and Welding Engineers' units. In this method, a male mold is carried upwards toward the clamped sheet. As the mold rises, air compressed between the top of the mold and the sheet forces the softened sheet into a bubble shape. Toward the end of the stroke, the male mold catches up with the bubble, the trapped air between the mold and the bubble is evacuated, and atmospheric pressure forces the sheet tightly against the male mold.

For forming substantially stronger and sharper corners in acrylic sheet, Rohm & Haas has come up with a new technique which eliminates many of the difficulties inherent in the conventional plug-and-ring method. The key to the Rohm & Haas method is a set of corner-forming dies which supplement the action of the male mold.

Experimental light diffuser (right) and package (left) formed of linear polyethylene. (Photo, Hercules)

Automation

Certain trends are also obvious in machine design. For one thing, the machines are bigger than ever before. The machine used by National Broadcasting Co., with a forming area of 12 ft. by 6 ft. (see "Thermoformed scenery for TV," MODERN PLASTICS, April 1957), probably holds the record; in Perkasie, Pa., Strick Trailer Corp. has installed a machine designed to form trailer linings up to 52 by 104 in. in size.

The second obvious trend is toward automation in three basic areas: automatic sheet-fed machines, automatic roll-fed machines, and automatic extrusion-forming hook-ups.

Sheet-fed machines. Conveyor and rotary types in which the sheet is carried to various stations where individual operations are performed have had considerable success. An example of the first type of equipment is General Electric Co.'s automatic machine in which the sheet travels around a loop conveyor which pauses at four points for removal and loading, heating, forming, and cooling.

Comet Industries' Rotary-Vac exemplifies the second type of equipment. In this unit a large turn-table revolves in front of the operator. Stopping at each 120° of travel places the clamping frame in front of the operator who can then unload and reload with a fresh blank. Using this technique, styrene refrigerator door liners, 0.100 in. thick, can be turned out at the rate of 120 to 130 pieces per hour.

Roll-fed machines. When working with the thinner-gage plastics, machines can be used in which a roll of material is hooked-up to the back of the unit and automatically fed through the forming operations. Because of the high speeds which can be attained and because only thin-gage material is involved, most of this work has been aimed at packaging markets. One application in the food packaging field, a small vinyl closure, for example, reportedly will soon be turned out on special roll-fed equipment capable of producing over 1000 units per minute. Not only will the equipment automatically feed the roll of vinyl into the machine and form it, but it will print it, blank out the formed pieces, dry the ink, stack the units, count them, and then package them in paper tubes.

In a paper given by Walter M. Ronayne of Celanese at the recent S.P.I. Conference in Los Angeles, Calif., roll-fed forming equipment was reported for the blister packaging of General Electric's flashlight bulbs. The package consists of a strip of formed 0.0075-in. acetate blisters heat sealed to a coated board. The acetate

Market ideas for reinforced plastics

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and the board are perforated between each blister to allow removal of individual units yet provide a complete strip to serve as an inducement for multiple purchases.

The equipment that was finally developed for this job by Packaging Industries, Montclair, N.J., automatically feeds the web of acetate, forms it, fills it, seals it, and perforates it in a continuous operation—at a rate of 12,000 to 18,000 units per hour.

Roll-fed equipment has also played a leading role in the success of the skin-packaging technique. One interesting variation has been devised by Thrifty Toy House, Seattle, Wash., in conjunction with Plastic Packaging Machinery Co., Inc., Renton, Wash. During the heating cycle, the platen with the items to be skin-packaged placed on it rises and pushes up against the clamped sheet. Vacuum is then pulled, the sheet forms over the items, and the platen is lowered. This technique gives an area around the loading platform that is open and flat, permitting conveyor operations to both sides of the platen—essential in the set-up of any in-line, continuous operation.

Extrusion-forming hook-ups. The pros and cons of this type of automatic forming set-up are still being debated. But it seems generally agreed that it is economically feasible only when the formed part can account for a relatively large volume of material or continuous production over a number of years.

One successful operation of this type has been reported by Rosenberg Bros. & Co., Smithtown, N.Y. Basically custom and proprietary extruders, Rosenberg recently decided to diversify its activities by going into an extrusion-forming set-up aimed at turning out toys, novelties, packages, etc. A system was set up whereby the extruded sheet is carried on a series of heated rollers into the heating chamber. Here, the female mold, which travels on a trolley system, descends onto the sheet and the vacuum is pulled. The mold travels along with the sheet at the same rate of speed as it is being extruded. At the end of the cycle, the mold is raised and travels back via the trolley system into the heating chamber where the operation is repeated. According to the company, this system has been able to turn out at the rate of 600 units per hour a novelty belt and buckle set formed of 0.030-in. polyethylene sheet. On smaller pieces, molds with as many as 50 cavities have increased production even more.

At the recent S.P.I. conference, R. J. Lee and J. W. Mighton of The Dow Chemical Co. discussed an extrusion-forming hook-up based on a plug-assist technique for economically turning out disposable containers. A single unit of this kind would have an equipment cost of approximately $70,000. Based on a trim regrind rate of 50% which might be encountered in forming circular pint containers, an extrusion rate of 350 lb./hr. would yield a production rate of 175 lb. of finished containers per hour. In parts per hour, this would be about 4000 units.

Kal Plastics has designed a continuous mechanical assist vacuum forming machine intended primarily for turning out thin-wall containers in large-volume quantities. The machine is capable of forming 2½-in.-square parts at a rate of 15,000 units per hr.; it operates directly from the mouth of an extruder or from roll stock.

Map of Palestine is vacuum formed of styrene sheet to exact topographical contours. (Photo, Emet)

Christmas tree display for outdoor use is formed of weather-resistant butyrate. (Photo, Eastman)

Progress in applications

While some areas of application — refrigerators, appliances, packaging, etc., — have already become obvious large-volume potential users of sheet formed plastics, others such as luggage, industrial components, transportation, etc., are just now beginning to show up as important new markets.

Packaging. Volume-wise, the packaging industry is probably the fastest growing market for sheet formed plastics today. Package designers generally recognize three basic groups: blister packages, skin packages, and contoured packages.

As indicated by the discussion of the General Electric flashlight bulb blister package, a good deal of the work in this area has been directed towards methods of automating the forming, loading, and sealing of the blisters. At the recent National Packaging Show in Chicago, The Valley-National Corp., Milldale, Conn., in conjunction with Plastic Packaging Machinery Corp., showed equipment for forming blisters from a web of acetate, automatically feeding the blisters and the item

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to be packaged onto a coated card, and sealing the blisters in place. Celanese's new acetate sheeting for food packaging was used; the items packaged were chocolate candies.

Skin-packaging is another development that is beginning to move into large-volume production. Such blue-chip companies as A. C. Gilbert Co. (for wire puzzles), The Parker Pen Co. (for ball point pen refills), Sears, Roebuck (for hardware, sporting goods, etc.), and other companies of like caliber are already sold on the technique and plan extensive use in the future. One company which only started to use the technique last year has already placed on the market between 5 and 6 million of a single skin-packaged item.

Contoured packages in which recesses are formed to the shape of the item to be packaged have been produced for everything from electronic parts to eggs. The latter type of package is being formed of 9-mil acetate by Kuhl Plastic Mfg. Co., Flemington, N.J. in two hinged sections. New decorative effects possible with plastic sheeting have also pushed thermoforming into the field of contoured luxury-type packages. Emet Plastics Corp., Bronx, N.Y., for example, is turning out for Lucien Lelong a handsome perfume package using both metallized and flocked acetate sheeting.

Two other noticeable trends in packaging deserve mention. The first is the emphasis on plastics for food packaging. This field already covers a wide range—from formed acetate tomato and egg cartons to Shaw-Randall's formed polyethylene container for cottage cheese.

The second is the research into the possibilities of forming disposable thin-wall containers at a price competitive with paper and foil. Since disposable ice cream containers and disposable hot drink vending cups—only two of the possibilities—each have an annual 1.5 billion unit potential, the activity certainly seems justified. To make these products economically feasible, much of this research is being directed towards minimizing production costs through the use of automation, primarily that based on extrusion-forming hook-ups discussed above.

Refrigerators. Door liners, crisper trays, and similar components formed of high-impact styrene still stand out as volume leaders in the refrigerator industry. Most of the activity in this field has been concerned more with improved and faster production line set-ups than with new design or application features.

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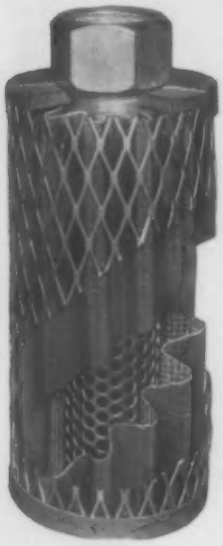

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the end of the heating cycle, the mold is raised so that it pushes into the softened sheet and the vacuum is pulled. The table then rolls out from under the heater and the formed piece is removed.

Signs and displays. More imaginative design, a sounder use of the new decorated plastics sheetings, and a trend toward bigger pieces characterizes the formed sign and display field—which probably absorbs close to 15% of the plastics sheet going into thermoforming, primarily acrylic. Newhart Products, Devon, Conn., for example, is forming an unusual display for women's lingerie out of high-impact styrene sheet in an attractive woodgrain pattern. The 0.156-in. sheet from which the piece is formed measures 26 by 38 inches. The finished trimmed part measures 24 in. by 36 in. and is 10 in. tall. According to the manufacturer, the cost of the basic design, development samples, production mold, etc., was well under $1000. The woodgrain sheet was supplied by Chicago Molded Products and Gilman Bros.

Formed signs and displays for outdoor use are also beginning to grow in importance. Some of the earlier formed butyrate signs, for example, have been out in the field for two to three years and the fact that they are still in good condition is expected to encourage new production facilities. Two of the newer outdoor applications formed of butyrate have been introduced by General Plastics Corp., Marion, Ind.—a contoured Christmas tree that attaches to the outside of a building and a formed brick-type wall covering that can be used outdoors as well as indoors. Acrylic, of course, has continued its steady climb upward in this outdoor market.

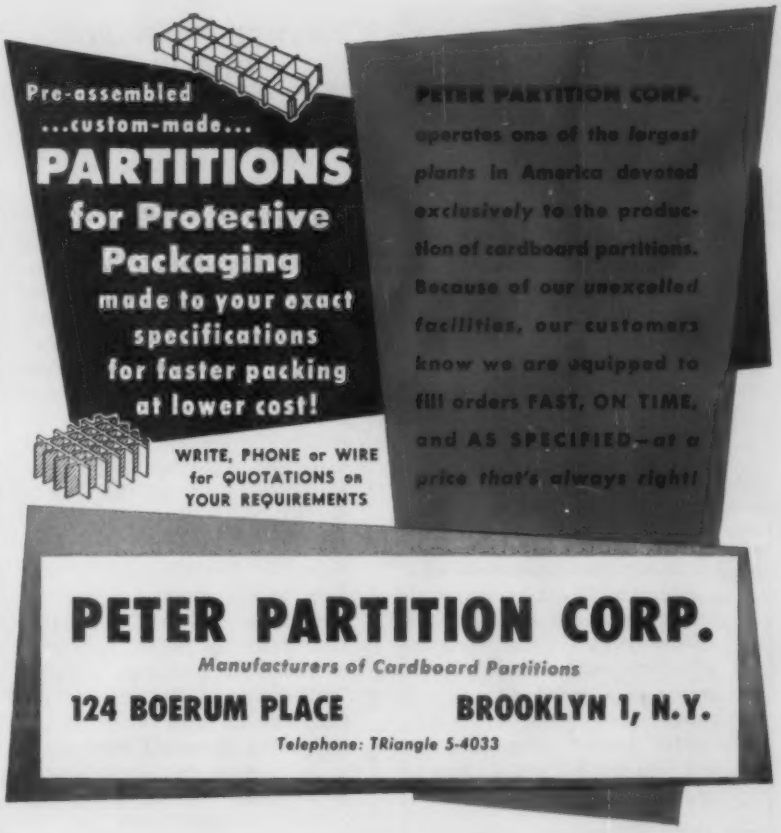
Toys and novelties. The booming market for toys, with 1956 retail sales at a record peak of $1,344,000,000 is feeling the impact of forming. Model planes, boats, and automobiles are developing into one of the most important of the formed application groups. Last year, a number of vacuum formed scale model kits were put on the market. This year, thermoforming is turning

out not only small scale models but larger models of boats and cars which the child can actually sit in and use. Typical of these applications is the Pirateer Skiff formed of styrene sheet by Plastiform Co., Ypsilanti, Mich. Measuring 5 ft. in length, the skiff is filled with styrene foam, weighs only 10 lb., and can be propelled through the water by a youngster sitting on the bottom and paddling with both hands. A pedal-operated automobile for youngsters formed of an ABS polymer blend sheeting will also be placed on the market sometime this year.

Toy manufacturers have supplemented last year's formed 3-D paint sets with a number of new products for the creative hobbyist. These include formed molds for do-it-yourselfers who cast their own plaques, book ends, or other decorative pieces. Manufactured by Deko-Mold, Inc., Baltimore, Md., the set comes complete with 18 re-usable female casting molds formed of high-impact styrene sheet. Blackboards formed of styrene sheeting, such as those produced by Blackman Plastics, Culver City, Calif., have also attracted considerable attention.

Transportation. The automotive field stands out as the biggest consumer of plastics sheeting in the area of transportation, with ABS polymer blend sheet accounting for the major share. Estimates of last year's consumption of the styrene sheeting by the automotive industry ran as high as 6 to 8 million lb.—about the same as 1955. The ratio between rigid sheeting and the new elastomeric sheeting began to change, however, in favor of the flexible materials used for crash pads and window moldings. Rumor also has it that formed car headliners will be coming back shortly.

Some of the newer applications for thermoforming in the transportation field have been found more recently in the truck and aircraft industries. One exciting innovation in the trucking industry, for example, was the recent installation of a large vacuum forming machine by Strick Trailer Corp. to produce linings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for their own trailers as well as trailers put out by other manufacturers. Strick's machine can form thermoplastic sheets up to 52 by 104 in. in size and has already been used for turning out over 10,000 lb. of large contoured parts. Strick has thus far been using primarily ABS polymer blends, but experimental samples in linear polyethylene have also been made.

In aircraft applications, Cessna Aircraft Co., Wichita, Kans., started using sheet formed parts about five years ago and has progressed to the point where today over 100 assorted parts ranging from a wheel hub formed of ABS polymer sheeting to a high-impact styrene upholstery backing panel, are being used in one model.

Boeing's 707 jet transport also makes extensive use of formed ABS polymer blend sheeting. Applications range from side seat panels and overhead hat rack panels to individual control "pods" located over each seat and containing lights, air blowers, and call buttons.

Building. Thermoforming's contributions to the building industry have thus far been in the design of light diffusers, wall coverings, and, most recently, furniture. In the latter area St. Regis Paper Co., Panelyte Div., has come up with a new one-piece formed drawer that features a seamless interior with all inside corners smooth and rounded for easy cleaning with a damp cloth. Formed of high-impact styrene, the drawers are dimensionally stable, will not warp or splinter like wood, and are resistant to grease, alcohol, and most household chemicals. Runners are formed into the sides of the drawer.

Lighting diffusers formed primarily of acrylic, vinyl, or styrene, have continued their invasion of the residential and industrial building fields. Similarly, formed wall coverings, such as formed styrene rectangular tile and formed vinyl brick coverings, have increased their stake in the market. One of the newest is a vacuum formed vinyl wall covering that reproduces fine imported hand-laid ceramic tile. As produced by W. L. Stensgaard and Assoc., Inc., Chicago, Ill., in sheets 2 ft. by 4 ft., the sheet is preprinted before forming in a variety of colors; contrasting colors are then rubbed into the depressed areas to emphasize the separation lines. The sheet sells at less than 1/10 the cost of imported tiles.

Luggage. The $200 million annual luggage market is a fertile ground for thermoforming developments. Already on the market are three versions of formed plastics luggage—two are made up of shells formed entirely of ABS polymer sheeting, the third uses shells consisting of the polymer sheeting formed over a molded resin-impregnated cellulose fiber-fibrous glass core (see "Luggage is going places with copolymer sheet," MODERN PLASTICS, Nov. 1956). A fourth model by a leading luggage manufacturer made up of a formed shell over a wood frame will soon be marketed.

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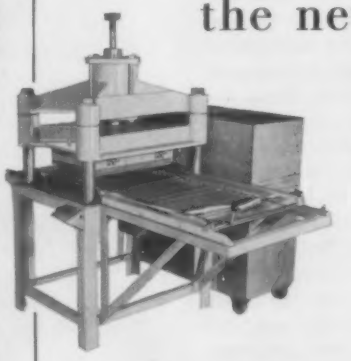

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has fathered plastic relief maps as educational tools. The Armed Services' adaptation of the idea is already well-known and consumer applications are moving along at a fast clip. Aero-Service Corp., Philadelphia, Pa., for example, recently introduced a 61 by 42 in. self-framed map of the world, lithographed in 10 colors and formed of high-impact styrene to exact topographical contours.

First globe-type pressure formed relief map for school use was placed on the market this year by Geo-Physical Maps, Inc., New York, N.Y. Formed of high-impact styrene by Plaxall, Inc., Long Island City, N.Y., the two halves of the globe are joined at flanges. The globes are formed of white styrene which can be painted in water colors by school children. A special finish sprayed on the styrene sheet after forming makes it possible to wash the colors off and repaint the map over and over again.

Industrial applications. Formed industrial applications probably cover a wider area than any other group. Considerable activity has been noted during the past two years in tote boxes formed of high-impact styrene, ABS polymer blends, or vinyl. These contoured boxes have thus far been used primarily for carrying electronic or other fragile parts or unusually shaped items. More recently, field boxes used by farmers when picking fruit have been studied. Although such boxes would cost at least four times as much in formed styrene as do the wooden boxes currently used, the long life, light weight, and minimum maintenance of the plastic boxes justify the extra cost. One major fruit packer reports that during a typical season some 3 million boxes are used by pickers.

Housings have also grown into an important outlet for formed plastics. For a large photocopying machine being marketed by Duophoto Corp., New York, N.Y., for example, Tiger Plastics, Brooklyn, N.Y., is forming a housing of 3/16-in. ABS polymer blend sheeting. The finished housing, made up of four separate pieces, measures 25 in. wide, 18 in. deep, and 16 in. high.

In a new type of Coca-Cola dispenser, the bright white dome housing and the red base shroud are formed of butyrate sheeting; the front grille of the unit is formed of 0.060-in. clear butyrate, metallized on its reverse surface. All the parts for the colorful housing were formed by General Plastics Corp., Marion, Ind., using a combination of vacuum, pressure, and snap-back methods. The dispenser is marketed by Glascock Bros. Mfg. Co., Muncie, Ind.

Two of the unusual applications only recently introduced are a formed garage door panel and a formed plastics cowl and motor housing for a fan. The garage door panels, made by Halsen Products, Philadelphia, Pa., are formed of 0.060-in. high-impact styrene sheet backed up with Masonite. The plastic panels eliminate problems of warping or splitting common to wood panels and show greater adaptability to attractive design and production economies.

The new fan is making a strong bid to antiquate conventional home and office fans. Instead of whirling metal blades to disperse the air, the Filter Jet fan, produced by Chemex Corp., New York, N.Y., uses whirling filter-paper disks inside a flying-saucer shaped cowl. Both the cowl and motor housing are formed of ABS polymer blend sheet by Speck Plastics, Port Washington, N.Y. On the 21-in. models, the cowl is formed on a single mold which has an interchangeable insert to form the front or the back half of the cowl. On the 12-in. models, cowls are formed on a four-cavity mold with two cavities for the front and two cavities for the back.

Future for thermoforming

Application-wise, there is a fine future in store for sheet formed plastics—just as soon as a few more bugs are ironed out on the new materials and the new forming techniques. On the shelves of fabricators throughout the country already sit samples of fantastic possibilities ranging from formed plastics shoe heels to caskets formed in one piece of tough plastics sheet.—END

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SAMPLE COLORS FOR PLASTICS. Folder describes company's colors for plastics, including vinyl chips and dispersed powders, and polyester, plasticizer color pastes. Contains attractive display of vinyl chips in many colors. Vansul Sales Company. **(E-701)**

ELECTRIC HEATING UNITS. Illustrated folder describes line of tubular heaters, heating bands, and platens for a variety of plastics processing applications. Thermel, Inc. **(E-702)**

TIMING APPARATUS. Illustrated folder describes the "Cycl-Flex" reset timer for opening or closing circuits in equipment such as in heaters and molding presses. Includes detailed wiring diagrams. Eagle Signal Corporation. **(E-703)**

ANTI-STATIC CONCENTRATE. Literature describes concentrate for destaticizing plastics and for preventing static-caused dust and dirt. Applied by dip, wipe, spray, or brush methods. Merix Chemical Co. **(E-704)**

CUSTOM FIBERGLAS MOLDING. Brochure describes facilities, contains case-history discussions of California company's Fiberglas custom molding service. Applications range from luggage to radomes. H. Koch & Sons. **(E-705)**

INJECTION HEATING CYLINDER ACCESSORIES. Catalog illustrates and describes line of heater bands, thermocouples, and controllers for injection presses. Prices are included. Injection Molders Supply Co. **(E-706)**

HYDRAULIC DIE PRESSES. Illustrated folder describes line of hydraulic die presses with cutting pressures of 55,000 to 200,000 lbs. Lists sizes and capacities of presses. Atlas-Sandt Corporation. **(E-707)**

VISE FOR TOOL AND DIE MAKING. 8-page booklet illustrates applications for new vise used in the manufacture of dies and tools. Illustrates use in surface grinding and milling operations. Illinois Metal Products. **(E-708)**

STATIC DETECTOR. Literature describes the "Statigun", a portable instrument that locates and measures electrostatic charges on plastics. Describes operating procedure, accessories. Herman H. Sticht. Co., Inc. **(E-709)**

ELECTROFORMED MOLDS. Folder discusses company's electroformed nickle plated precision cavity molds for plastics processing. Discusses features and properties of molds. Raidon Company. **(E-710)**

CUSTOM MOLDER AND EXTRUDER. 8-page illustrated booklet discusses Ohio company's custom extrusion of gaskets, tubing, and profiles. Also discusses injection molding and fabricating service. Yardley Plastics Co. **(E-711)**

DRUM ROTATORS. Catalog folder describes and illustrates line of drum handling equipment including drum cradles, lifting hooks, and a motor-driven drum rotator for tumbling, mixing, blending. Morse Manufacturing Co., Inc. **(E-712)**

PLASTICIZERS FOR VINYL RESINS. Folder describes two high molecular weight polyesters recommended for all types of vinyl compounding. Includes physical properties and performance data. Archer-Daniels-Midland Company. **(D-713)**

RUBBER COVERED ROLLS. Folder describes rolls available with natural, synthetic rubber, and rubber-like plastic coatings for embossing, printing, coating, and similar operations. Tyer Rubber Company. **(E-714)**

ROTARY GRANULATORS. Folder illustrates and describes two rotary granulators for plastics materials. Also describes granulator equipped with cooling fan for working heat-sensitive or warm plastics. Includes specifications. Lukens Laboratories. **(E-715)**

CARBON BLACK IN POLYESTERS. 20-page technical booklet describes cure studies on unsaturated polyester-carbon black mixtures. Includes technical analysis of carbon black as an inhibitor and accelerator. Discusses hardness characteristics. Columbian Carbon Company. **(E-716)**

VACUUM FORMER. Literature describes combination drape and vacuum former with 30 x 30 in. capacity that can drape draw to depth of 16 inches. Size of machine is 32 x 32 in. x 7 ft. Kroll Equipment Corp. **(E-717)**

TEMPERATURE CONTROLS. Illustrated folder describes electric indicating temperature control instruments with range of 50 to 250 degrees and special units to 400 degrees, particularly suitable for controlling temperature in plastics molding. Sarco Company, Inc. **(E-718)**

GLOSSARY OF PLASTICS TERMS. 4-page glossary provides capsule definitions of terms used in plastics technology. The Richardson Company. **(E-719)**

AUTOMATIC PREHEATER. Data sheet describes unit that loads, heats, feeds powder or preforms automatically into all types of presses. Includes specifications. W. T. La Rose & Ass'n., Inc. **(E-720)**

BLENDING EQUIPMENT. 16-page illustrated catalog describes applications for twin shell blender that disperses dry materials into liquids. Includes detailed specifications, cross-section diagrams. Also describes heat transfer. The Patterson-Kelley Co., Inc. **(E-721)**

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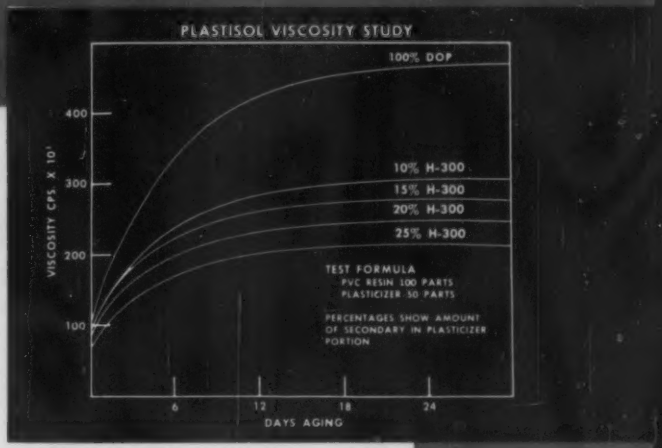

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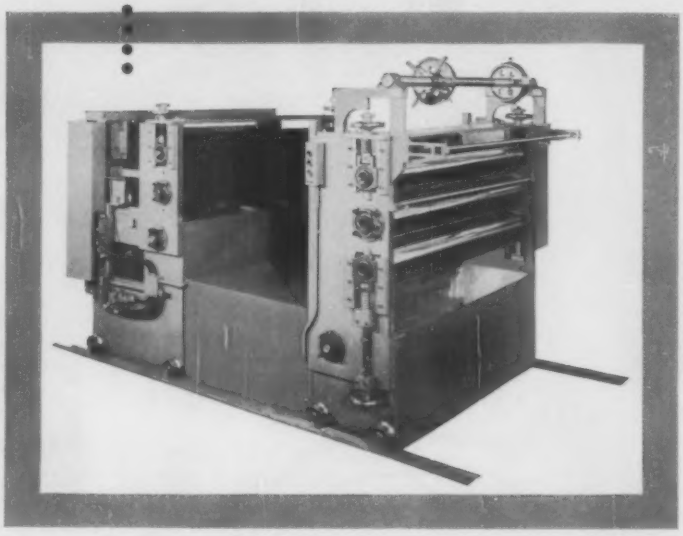

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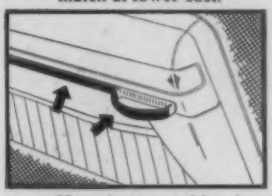

In this instance a solid extruded vinyl plastic was given an embossed leather grain surface, colored and textured to match or contrast with seat fabrics, and firmly secured to a flexible metal core.

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Adhesive in film form

(*From pp.* 112-114)

be adhered to a prefabricated rigid section, the new film adhesive has the facility of being able to offer to the manufacturer or to the assembler the following three alternative application methods:

1) The adhesive in full or partial sheet width can be rolled onto the rigid surface. The pressure-sensitive side "grabs" instantly so that merely hand pressure is sufficient to complete the bond. Whenever the release paper on top is peeled off, the flexible materials, such as tiles, for example, may be placed in position and pressed down.

2) The new adhesive film can be pre-cut into squares, rectangles, circles, or any irregular shape. These may then be adhered to the underside of the tiles or to the underside of whatever flexible or rigid material is being assembled. Later on, the release paper is peeled from the individual pieces and they may be placed in position and pressed down.

3) The tile manufacturer, the high-impact styrene panel manufacturer, the decorative wall covering manufacturer, etc., may market his product already covered on the underside with film adhesives, already die cut to the individual shapes or sheet sizes required.

Teflon tape

Another new and current application is the development of a Teflon tape by Enflo Corp., Pennsauken, N. J., using this pressure-sensitive adhesive. The tape—either single- or double-faced with Tackmaster—is bondable to glass, steel, aluminum, plastics, or almost any other material, including Teflon itself. Any material that can be used to bond heretofore almost "stickless" Teflon should add materially to the practicality of that material.

Applications of "bondable" Teflon range from ski, ironing board, and rolling pin surfaces to pipe, bearing, hopper, and vat linings, to hermetic seal or low-friction surfaces, motor or coil winding insulation, and hundreds more.

Some of these applications, because of the relatively higher surface temperatures involved or because of the demand for elimination of creep stresses, etc., call for the use of epoxy resin adhesives and the many successful installations of that type are well known.

However, where the other properties of Teflon have been sought and where rigidity of bond is not essential—as in tape for splicing high-voltage wire, for example—hitherto unfilled demand has existed for a true pressure-sensitive Teflon tape. The new film adhesive provided an efficient answer and makes possible a pressure-sensitive tape which can be used for splicing cable up to 15,000 v. with advantages such as higher insulation to ground, zero moisture absorption, long life span, and ease of application. It can be applied like ordinary friction tape.—END

Polyethylene film

(*From pp. 117-120*)

durable to retain its moisture proof properties during the time it is applied to the surface of the concrete. It shall comply with the requirements of Article 4145.01 for retention of moisture in concrete and for size of sheets. (This means no greater than a 5% moisture loss can be tolerated.) The color of plastic film shall not be darker than the normal color of Portland cement concrete. If the thickness of plastic film is less than 0.004 in. it shall not be used more than once for curing concrete."

Because of the cost of barrier papers, contractors re-use them for highway curing. Since the paper absorbs moisture, second use finds it heavier and more prone to tear than before. Four-mil polyethylene film has none of these disadvantages.

South Carolina, Minnesota, and several other states are using polyethylene in the construction of concrete highways. The film is used as a sub-grade moisture barrier and also as a moisture barrier on top of poured concrete to facilitate curing. Contractors have indicated that it is efficient and inexpensive; it is also easier to handle than paper, eliminating a good deal of ripping and tearing.

There is every reason to believe that the use of polyethylene film in road construction both as a sub-grade barrier and a curing barrier will continue to grow as highway expansion programs grow. In 1956 nearly 40 million sq. yd. of concrete highways were poured. This could mean a potential of 5 to 6 million lb. of polyethylene if highway construction maintained this pace. The Portland Cement Association reported that, in 1955, 840.6 million sq. ft. of concrete were poured for highways, streets, alleys, and airports.

Protective covering

Perhaps a less spectacular but important use of polyethylene film is as a protective covering. Again, light weight, easy handling, and moistureproofness make it ideal as a tarpaulin-type cover for machinery and materials which must be stored exposed to the elements.

One of the most dramatic applications of polyethylene is for enclosing construction work. The construction trade calls this "hoarding." Polyethylene transmits light and at the same time permits solar heat to be developed inside the enclosure, thereby raising the temperature and improving working conditions in cold weather construction. Thus, it is even possible to have more predictable working schedules in winter than in summer.

Generally, polyethylene is considered in the construction industry as a replacement material for moistureproof papers, tarpaulins, and curing compounds. Asphalt-treated papers are available in a wide range of grades and prices. For example, the cheapest grade of kraft building paper retails at about 0.6¢ per square foot. At the other extreme are aluminum- and copper-coated papers ranging up to 4¢ per square foot. The most commonly used top-

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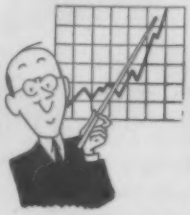

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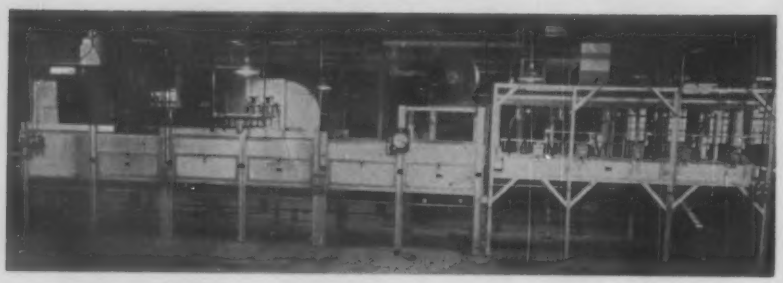

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quality papers sell for about 2¢ per sq. ft. to the contractors. At the lower-price extreme for all-purpose barrier use, a paper may sell to contractors for slightly over 1¢ per square foot. Thus, the practical range of prices for papers competing with polyethylene is between 1 and 2¢ per square foot.

Four-mil polyethylene film is normally priced at about 2¢/sq. ft. and 2-mil film at about 1¢/sq. ft. Thus, 4-mil polyethylene can compete on an equal basis with the quality-type, reinforced barrier papers. The various gages of film make it competitive price-wise with most comparable building papers. Polyethylene's rot resistance, long life, and efficiency will make it a strong factor in the moisture-barrier markets for the construction industry.

Marketing and distribution

Marketing problems are the big headache. A recent advertisement in a national publication concerned polyethylene as a moisture vapor barrier under crawl spaces. Over 6000 inquiries were received. They came from home owners, contractors, jobbers and distributors, and retailers. Requests came for film in various sizes and thicknesses and in quantities from a few square inches to thousands of square feet.

This brought up the question: "I want to cover a crawl space using polyethylene. Where do I buy it and how much does it cost?" Here lies the tremendous marketing challenge. How to make it easy for John Smith, home owner, to buy a roll of polyethylene to cover the ground under his crawl space? If John Smith is a contractor, where does he buy the dozen rolls?

Merchandising programs must be developed to sell building contractors, home owners, and others. Consideration must be given to which channels of distribution will best serve particular markets. Hardware stores? Lumber yards? Implement dealers? Should jobbers or wholesalers be used? Should distribution be on an exclusive basis? How about pricing structures? Mark ups? What widths and lengths of rolls should be used by contractors, farmers,

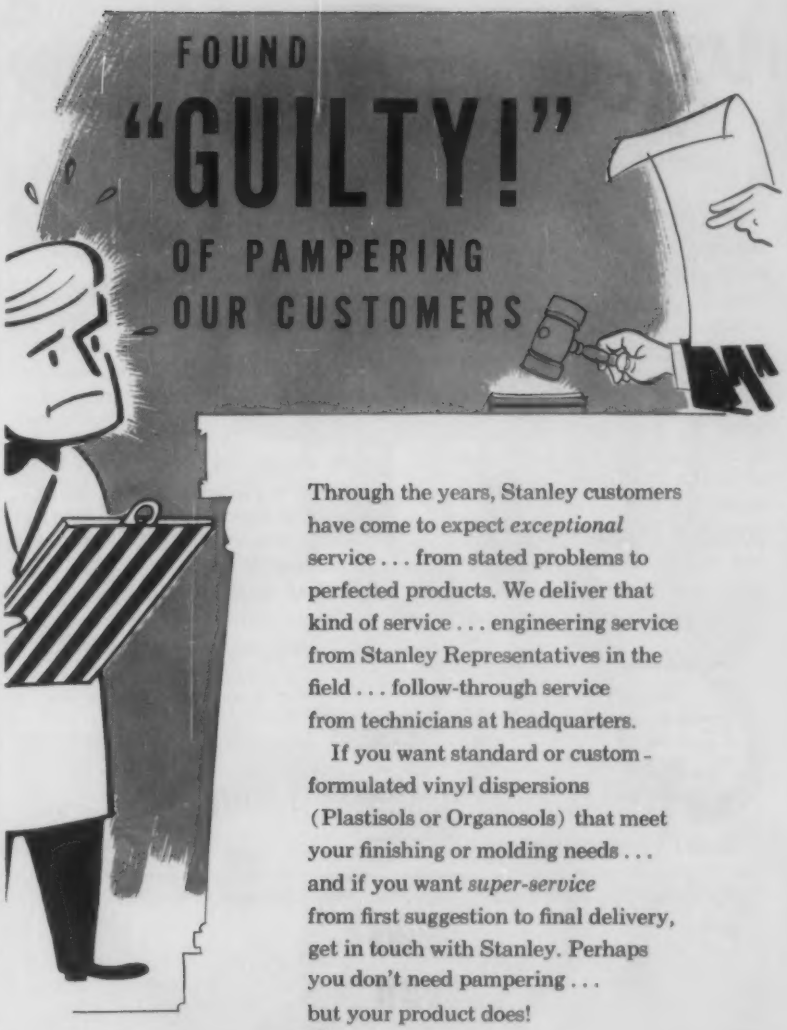
home owners? How should promotion be conducted at the local level? These are just a few of the many problems.

Undoubtedly the greatest problem in developing the market for polyethylene film in construction uses has been that of distribution. In many cases the extruders have little knowledge of the construction business. Thus, extruders face the problem of introducing a new material to the construction trade. But they have to gain knowledge of the trade, they have to answer such questions as:

1) To whom do we go to sell polyethylene in the construction industry? 2) What are the normal channels of distribution in the construction trade? 3) At what place in the distribution channels should the extruder sell his film? 4) What materials will he be competing against? 5) What new uses in construction can polyethylene film handle? 6) What price must the film be sold for to compete effectively? 7) How thick a gage of polyethylene is needed for each use? 8) How wide a film is needed for each use? 9) What tests and codes must be passed or met to get polyethylene film approval?

As little as one year ago the question of distribution channels was still a great problem. Since then, much progress has been made but the nationwide distribution picture is still not complete. It is now possible for builders and contractors to get information on the use of polyethylene film in construction and then buy the film in most major cities through such outlets as 1) lumber yards; 2) building supply houses; 3) suppliers of building paper and similar materials. A "do-it-yourself enthusiast" can generally get adequate quantities and information from Montgomery Ward, Sears Roebuck, hardware stores, or lumber yards.

Behind these varied outlets there is the possibility that "plastics yards," supplying a variety of plastic materials for construction, might suddenly make an appearance. If plastics pipe, film, and other building materials continue to grow, distribution by an expert merchandiser in the handling and application of plastics is not at all inconceivable.—END



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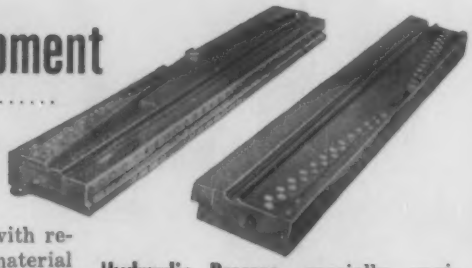

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(*From pp.* 128-131)

swimming pools will be presented in an early issue of MODERN PLASTICS Magazine.

"Chemical Properties of Plastics in the Petroleum and Process Industries" were discussed by Dr. Raymond Seymour, Loven Chemical of Calif. Dr. Seymour showed that the use of plastics in these industries is governed by temperature, type and concentration of solvents, type and concentration of corrosives, and basic engineering requirements. Where plastics have failed in this field, such failure can be traced to mistakes in selection, purchasing, installation, and maintenance.

A panel discussion on the above subjects was participated in by H. D. Boggs, Fibercast Corp.; W. O. Bracken, Hercules Powder Co.; C. Condit, S.P.I.; L. B. Crowley, Phillips Chemical Co.; H. Dague, Collins, Caldwell and Dague; J. F. Malone, The B. F. Goodrich Chemical Co.; Dr. J. A. Neumann, American Agile Corp.; A. K. O'Keefe, Naugatuck Chemical, Div. U. S. Rubber Co.; C. S. Perkins, Union Oil Co.; R. Seymour, Loven Chemical of Calif.; J. A. Shelton, E. I. duPont de Nemours & Co., Inc.; T. Stevenson, Sloane Mfg. Co.; L. Tallman, Dow Chemical Co.; H. Yackey, Suburban Water Co.

Plastics in packaging

Chairman for this session was Richard Hough, Celanese Corp. of America.

"Dylite Polystyrene Foam—A New Concept in Packaging" was presented by E. A. Edberg, Koppers Co., Inc. Expandable polystyrene beads confined in molds become rigid parts and products with very light weight and a strong skin. The molded foam has good energy absorption characteristics and has advantage in many kinds of protective packaging.

"Formed Cellulosics—Present Uses and Future Horizons for Packaging" was the subject of a paper by W. M. Ronayne, Celanese Corp. of America. Tough,

transparent cellulose acetate and butyrate are the leading plastic sheet materials used in thermoformed packages. Three basic packages were discussed—blister or bubble packages, skin packages, and container packages. Information from this paper has been included in the article "Progress report on sheet thermoforming" beginning on page 107.

"Zytel Nylon for Packaging" was presented by W. M. Ryan of E. I. duPont de Nemours & Co., Inc. This discussion was chiefly concerned with aerosol containers blow molded or injection molded in parts and spin welded. Data were presented on permeability, environmental testing, and design. A comprehensive article on this subject will appear in an early issue of MODERN PLASTICS Magazine.

"Significant Factors in Plastics Container Fabrication" were highlighted by R. J. Lee, Dow Chemical Co. This paper indicated the kind of theoretical cost accounting that, if used before the fact, would save plastics fabricators a lot of grief. The problem was to decide whether it would be more economical to make ice cream containers by injection molding or by vacuum forming of hot, extruded sheet. Information from this paper is included in our lead article in this issue.

"The Role of Polyethylene in Creative Packaging and Successful Selling," by J. R. Akers, Bakelite Co., was a review of past accomplishments in polyethylene packaging and an analysis of prospective business.

Plastics as building materials

James Watt, Monsanto Chemical Co., presided.

Monsanto's House of the Future —its design, its components, and its decoration and furnishings— was discussed by R. P. Whittier, Monsanto Chemical Co. Complete coverage of this subject will appear in an early issue of MODERN PLASTICS Magazine.

"Status of Building Codes and the Industry's Approach to Code Problems," a paper presented by

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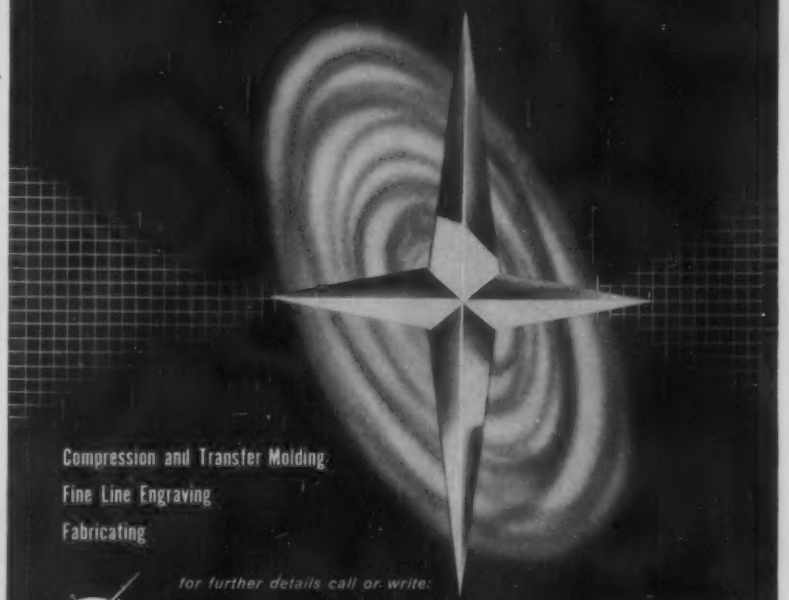

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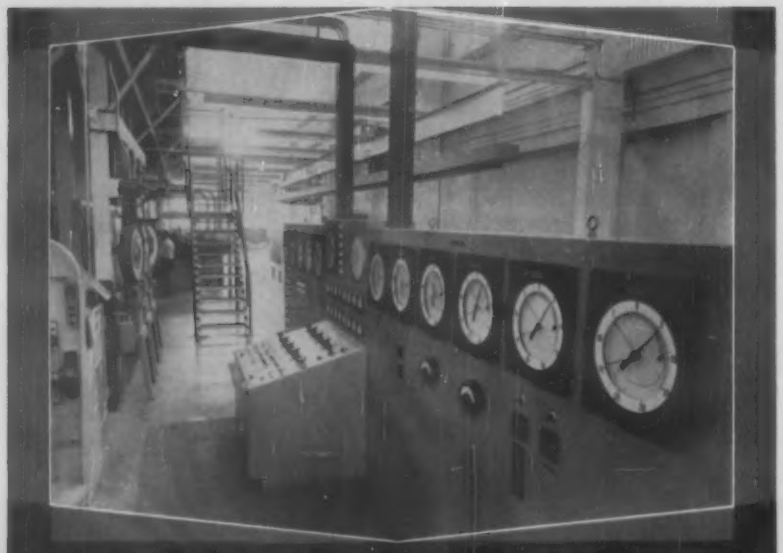

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F. X. Ambrose, Alsynite Co. of America, was a history of two years of intense work on the part of the S.P.I. Code Advisory Committee. This work involved the building of a model chapter on plastics for inclusion in a building code. MODERN PLASTICS will publish a complete review of this activity in the near future.

A panel discussion on **"Plastics in Home and Garden"** was moderated by W. L. Doty, Editor, *Sunset Magazine*, and participated in by A. Q. Jones, architect; G. Eckbo, of Eckbo, Royston & Williams; G. Hermach, Architectural Plastics Corp.; and W. Fry, Fry Plastics Co.

The Exposition

There were few really new materials, services, or pieces of equipment presented at this first Pacific Coast Plastics Exposition, but there were some developments worthy of mention.

Rohm & Haas Co. announced clear and colored acrylic sheets 102 by 120 in.; largest previously available were 67 by 120 inches. The same firm presented its new Paraplex P-444 polyester-acrylic alloy resin which has exceptional resistance to weathering and discoloration and, when used with glass reinforcement, produces a quite transparent sheet because the refractive index of the cured resin is approximately that of fibrous glass.

Semet Solvay Petrochemical, Div. of Allied Chemical & Dye Corp., presented its polyethylene-6 as an injection molding material compatible with all types of polyethylene resins.

Reichhold Chemical Co. announced new tooling compounds of the premix type and also a urethane foaming process which is available under license.

General Fiber Inc., Div. of General Plastics Corp., presented a new line of premixed fibrous glass molding compounds in special bright colors.

Polymer Process Inc. presented its "Whirlclad" coating process, wherein metal parts may be coated with nylon polyethylene and other plastics in dry fluidized powder form. The company owns the patent rights to this German process in the United States and

will license manufacturers or custom coaters to use it.

The Fibercast Corp., Div. Youngstown Sheet and Tube Co., presented the first complete line of reinforced epoxy pipe and fittings.

Cadillac Plastic & Chemical Co. announced that it will distribute Campco impact alloy styrene sheet and butyrate sheet on the Pacific Coast.

Eastman Chemical Corp. announced two new plasticizers, one a polymeric material and the other dinonyl phthalate.

Automatic Molding Machine Co. presented its model A50-B, which is larger than its previous fully automatic presses and provides higher tonnage with lower air line pressure.

Oronite Chemical Co. showed the results of molding polyesters made with the use of its isophthalic acid.

C. H. Dexter & Sons Inc. presented a new backing material for lightweight vinyl sheeting which has on one side heat sealable thermoplastic fibers and on the other side absorbent fibers for the application of adhesives.

Aerojet-General Corp. had on view a number of specialized pressure vessels produced by filament winding as discussed in the article on page 132 of the March issue of MODERN PLASTICS Magazine.

Narmco Resins and Coatings had a new line of adhesives for the creation of composite structures, especially in aircraft.

Hexcel Products Co. featured new high heat-resistant honeycombs.

Swedlow Plastics Co. showed a new line of metallized reinforced plastics moldings which are highly heat resistant and the technology of which will be discussed in an early issue of MODERN PLASTICS Magazine.

R. H. Windsor Ltd., had the first showing of its new 1044 Autoplas press with a single-stage, multiscrew preplasticizer.

Mesa Plastics presented a full line of diallyl phthalate high temperature molding materials designed to withstand elevated temperatures and high humidity.

Larc Products Inc. announced a new line of cast acrylic.—END

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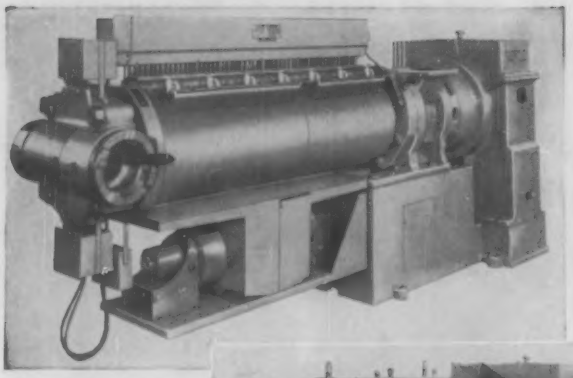

8½" Spirod extruder with side delivery head for jacketing. Upgraded from circulating type shown to the right.

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If you are operating an older type Royle extruder you should investigate up-grading to Spirod—the electrically heated extruder with high velocity evaporative cooling—for maximum efficiency in controlled operating temperatures.

Write for Bulletin # 463

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Estimating for

(*From pp.* 135-150)

rate (form 150-D). In estimating rates, production start-up load should be considered, since average production rates will not be attained until after the initial part of the production has been completed. Also, time should be allowed between setup of tools and start of shipment for the initial work in process to be completed. This is particularly important with large and complex products.

Comments and exceptions: This is a most important part of the summary sheet. All ambiguities, exceptions, and recommendations which aid the customer in understanding what the fabricator proposes to make for him must be clarified. In many cases, surface conditions, dimensions, tolerances, and the like must be further clarified to the customer. Sometimes, minor design modifications brought to the customer's attention result in cost savings. Explanations of this nature invariably head off expensive delays and misunderstanding after a proposal results in a purchase order.

Sample estimate: To aid the reader in better understanding the application of the estimating procedure, a sample estimate for the tank of Fig. 1 has been carried through in the reproduced forms. Cost factors shown are fictitious.

Developing better estimating

Because of the large responsibilities of the estimating function it is preferable to place estimating in the position of reporting directly to top management. Because estimating relies on information from practically every organizational function (sales, production, accounting, engineering, and tooling) it is necessary that estimating have free access to manufacturing, pricing, cost, sales, and engineering data.

Since estimating plays a large part in determining how jobs are to be performed and whether or not they will be profitable, the estimating function should be well organized and well manned. Management's efforts in this respect can be of great significance in the ultimate success or failure of the company.—END

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Recent trends

(From pp. 151-155)

with 40 parts by weight of phthalic anhydride to 100 parts by weight of basic epoxy (hereafter abbreviated as 40 p.p.h.). The basic epoxies vary from liquids of low viscosity to solids. However, the properties are quite similar, especially if the deformation sensitivity is considered. This is an indication that the amount and type of hardener is the determining factor in fixing the properties, rather than the type of base resin.

This is borne out in Table III, p. 155, where the properties are shown for a single resin, Bakelite ERL 2774, when cured with various anhydrides. There is a wide variation in deformation sensitivity, critical temperature, and magnitude of exothermic reaction during polymerization.

The curves of Fig. 4, p. 154, giving the variation of properties for Ciba Araldite 6020 with varying phthalic anhydride content, show a peak deformation sensitivity at 50 p.p.h. of hardener. Other considerations, such as ease of castting, tensile strength, and residual casting stresses, may indicate a backing down from this peak to 40 or 45 p.p.h. of hardener.

Pressure-vessel tests

With the proper technique and equipment, complicated epoxy resin models can be successfully machined, assembled, and tested. Figure 5, p. 154, shows a model of a pressure vessel, every part of which was machined from solid phthalic anhydride epoxy castings. The vessel, with a largest diameter of about 15 in., was made in three parts and cemented together. The head (or top) of the vessel is held down on an inside ledge by a large clamping ring (not shown). Nylon bolts with steel springs were used to hold the clamping ring to the vessel, the bolt force being determined from the deflection of the springs. A thin plastic ring was cemented to the vessel and the head for pressure sealing.

After preloading the bolts of the clamping ring, pressurizing the vessel, heating to the critical temperature, and slowly cooling to room temperature, the model can be unloaded and disassembled. Thin slices can then be removed in any desired manner and examined in the polariscope to reveal the stresses at any point.

Figure 6, p. 154, shows the stress pattern of a transverse slice through the top of the head. The maximum stresses occur at the narrow ligaments between the holes of the head at points *A*, *B*, and *C*. The greatest ligament stress occurs at point *C* and is equal to five times the internal pressure of the vessel.

Figure 7, p. 155, shows the stress pattern obtained from a radial slice taken between the two No. IV holes (Fig. 6). The pattern shows the stresses due to the bearing of the head on the ledge at point *A*. Point *B* shows where the clamping ring bears on the head. Part of the seal ring is shown at *C*, while *D* is a portion of the cap which has been cemented in hole No. II. Note the very high concentration of fringes at point C, which is shown enlarged in Fig. 8, p. 155. This indicates a rapid build-up of stress in that area. From such vertical slices as Fig. 7 the shear stress distribution in the ligaments can readily be determined.

Advantages and limitations

The stress "freezing" method of three-dimensional stress analysis can only be used to study elastic stresses in homogeneous materials. It is limited to steady state loading such as static loading or loading due to rotation at constant speed. However, in many cases, photoelasticity is the only method of experimental stress analysis, either because the stressed region is not exposed for the application of strain gages or brittle lacquers, or because the discontinuity is too small for accurate stress determination using the smallest practical gages, or because the stresses at an interior point of a solid object are required.

For stresses due to dynamic loading, the photoelastic coating method using high-speed photography or photoelectric devices to convert the photoelastic effect to an electrical signal offers promise as a useful experimental stress analysis tool.—END

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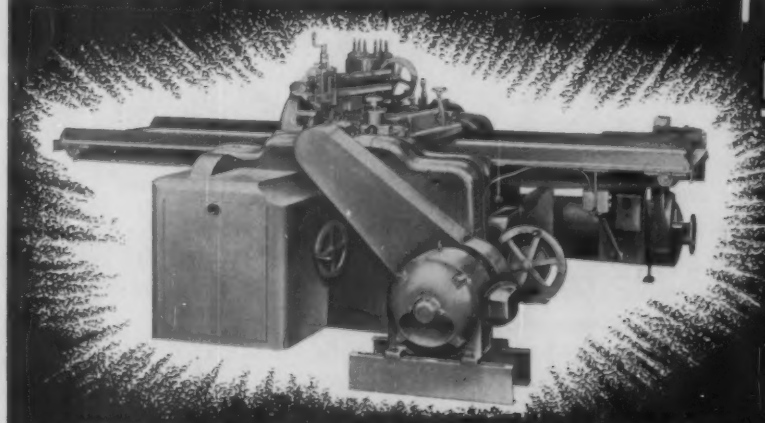

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Also newly available is RM 4100, a phenolic sheet molding material that combines arc, flame and heat resistance with medium high impact strength. It offers advantages over laminates in that both flat and shaped parts can be compression molded.

Preliminary data sheets on both materials are available. Please write Dept. P, Rogers Corporation, Rogers, Connecticut.

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Stabilization

(*From pp.* 170-176)

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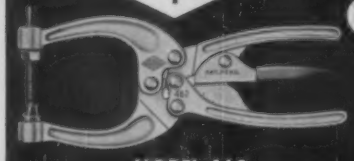

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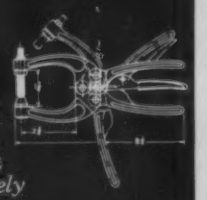

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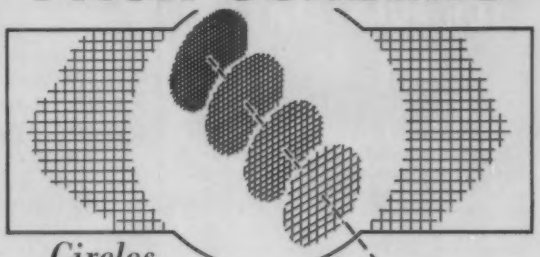

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Thermal conductivity

(*From p.* 168)

and core were approximate values (±15%) and the value for h is an approximation as explained, the excellent agreement shown in Table I should not at present be taken as an indication of the accuracy of the method. However, it does substantiate the method as a good approximation, the accuracy of which can be fully established when more experimental evidence is available. Moreover, the k approximation is of sufficient accuracy for preliminary design work when plastic honeycomb sandwich construction is employed.

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IN WOOD FLOUR SOMEONE ELSE'S FORMULA MAY NOT DO

Production conditions and requirements vary widely among plants using wood flour — even among plants in the same industry. A mesh analysis that is perfect for one plant may be too coarse, or too fine for another. One plant may be able to use a single grade of raw material while another requires a blend of two or more grades for best results.

To help with these, and similar problems, the Wilner Company maintains a continuing program of research and technical assistance, supplemented by the services of a leading firm of industrial research consultants.

These services are available at no cost, to help any interested concern in solving development or processing problems involving use of wood flour.

Typical Analysis 80 Mesh Wood Flour

Screen	On	Thru
70	Trace	
80		96.8%
100		79.2
140		57.6
170		45.6
200		32.8

Uses of Wood Flour

Wood flour is a *filler and extender,* adding strength, bulk, lightness and impact resistance to other more costly materials, such as plastics, linoleum, roofing felt, molded rubber products, wall board and vinyl floor coverings. It is an ideal *absorbent* for explosives, adhesives, rug and fur cleaners, stock feeds, and fertilizers (with built in insecticides?), and an effective *mild abrasive,* for cleaning metal surfaces, such as molds.

Other prospective uses include very fine filtration work; as a *binding agent* and *moisture absorbent* in ore processing; as an *anti-binding agent* to give desired porosity after burn-out in products like firebrick.

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Wilner Wood Products Co., Norway, Me.

Resin emulsion

(*From* p. 181)

is no longer 1 and the term "resin solids" is not the same as "total solids."

However, since "dissolved solids" also tends to follow the relation of Eq. 5 (with exceptions due to volume changes), the equation and nomogram are still approximately correct if "total solids" is used in place of "resin solids."

Where dissolved-solids density does not differ greatly from resin solids density, the calculations are correct to within a fraction of a percent.

Larger amounts of high-density dissolved solids (e.g., heavy metal salts) can result in an "apparent solids density" which is definitely higher than the pure resin densities.

This "apparent solids density" can be used in calculating the emulsion specific gravities for other solid contents.

Other applications

The same mathematical treatment can be employed to determine density of suspended solids or of finely divided solids in liquid medium (silt, resin beads, etc.).

Limitations

The accuracy of the solids versus specific gravity relationships drops off rapidly as the resin density approaches that of the liquid. Thus, for high butadiene latices, all solid contents result in the same emulsion specific gravity.—END

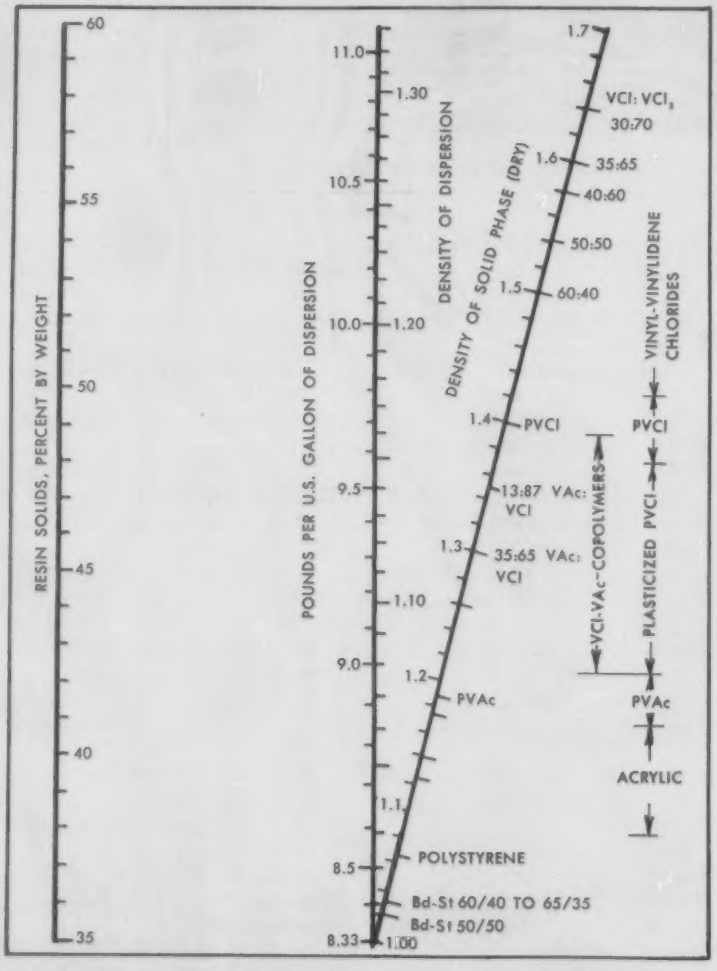

Fig. 1: Nomograph for identification of resins and for determining the relationship between solids content and resin emulsion density

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For many years, Waldron Engineers have studied the problems faced by the machine designer and have evolved several types for this purpose, with either radiant or drum preheating. In them Waldron Engineers found satisfactory answers to such problems as:

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- stretch and loss of width
- rewind tension
- speed in changing embossing rolls
- faithful reproduction of tints
- handling different varieties of plastics at suitable speeds

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The Plastiscope

News and interpretations of the news
By R. L. Van Boskirk

Section 2 *(Section 1 starts on p. 41)*

What makes vinyl run?

Vinyl chloride may not become the first billion-lb. plastic, but it can well become the first 2 billion-lb. plastic. This was the startling statement with which a prominent research director recently brought his audience to the edge of their chairs.

Much of the expected increase will come from new resins, improved handling processes, and consumer items that have not yet achieved large volume. But the history of vinyl shows that any attempt to set a limit or saturation point on its possibilities is nearly always fruitless; vinyl is the champion when it comes to breaking records that even its most ardent admirers didn't think could be broken.

Calendering grade. For example, calendering-grade resins used in the United States (including imported material) have grown from an estimated 40 or 45 million lb. in 1947 to something like 175 or 180 million lb. in 1956. Resin used for floor covering has grown from less than 10 million lb. in 1950 to 65 million lb. in 1956. Wire coating resins have grown from 15 or 20 million lb. in 1947 to somewhere around 80 million lb. today. Every one of these items has exceeded expectations held 5 or 10 years ago. Other items for which vinyl is used have not shown such spectacular growth, but there's no telling when any of them will burst forth with an unprecedented new volume.

The nice feature about so many vinyl uses is that they fit into large volume, well established markets such as floor covering and wire coating. One of these which vinyl has not yet captured in a big way is wall covering. The industry has been nibbling away at this market for several years without achieving large volume as compared with many other vinyl applications, but if present stepped-up activity is any criterion, this year may see the beginning of an upsurge in vinyl wall coverings that may start them well along the way as a major consumer of vinyl resins.

Wall paper production. There is some question in the trade as to just how big this market is. Wall paper production dropped from 411 million rolls in 1937 to 155 million in 1955, which was 8% above 1954, according to a statistical article in *The New York Times*, but which has not been confirmed by all the wall paper authorities. Sales were reportedly under $37 million. The same article stated that non-paper wall coverings were only 5% of that amount by physical volume, but 15% by dollar volume because of higher cost. Plastics operators don't agree on that physical volume figure—they think it was higher. Nor is there any information on how much of the paper was vinyl coated, although the percentage is thought to have been quite small. Obviously, the wall covering business has suffered from the do-it-yourself and emulsion paint trends.

The vinyl producers are out to reverse those trends and believe that a $37 million market for wall coverings is far below the inherent potentialities. Several important moves are apparent in their various campaigns. One is the effort to sell a lightweight covering for use in all rooms of a home instead of bathroom and kitchen only; heretofore, most vinyl wall covering has been used in institutions—hotels, hospitals, restaurants, etc. Another, and this may be the key, is a much greater use of laminated film to fabric which gives limitless printed design possibilities, ease of application, and according to laminators, is less costly and easier to handle than embossed, coated fabric.

Sales campaign. As an example of the vinyl wall covering activity, Velveray Corp. has launched a campaign to sell its Velvetex covering which is expected to increase sales by 37% in 1957. The material has had a thorough 2-year testing in hotels, hospitals, and commercial buildings and is now available in 126 styles. Velvetex is a 4- or 12-mil Ultron film laminated to cotton fabric (scrim) by an adhesive process. A specially formulated Velvetex paste is provided for adhesion to the wall. Velveray asserts that special plasticizers are used in the film to prevent shrinkage or separation at the seams. The covering can be hung on any kind of wall, including glass, steel, or sheet rock. Suggested retail prices range from $3.95 to $6.95 a roll for standard-weight Velvetex and $8.50 to $9.35 a roll for embossed triple-weight vinyl. The price is said to be competitive with medium-priced wall paper and gives permanence unequalled by paper and perhaps even paint. Over 6000 retail outlets will carry the Velvetex line.

Vinyl laminates for wall covering are not particularly new in the industry, but they have been largely the heavy, thick types put together by either pressure and heat or with an adhesive. In some cases, upholstery material has been used. Emphasis on this new, lightweight vinyl-to-fabric laminate may be the spark that will touch off a great expansion in the wall covering market.

Velveray, which is celebrating its 39th anniversary this year, is considered not only the country's largest flocking processor in the textile industry, but was an early converter of vinyl film: the com-

*Reg. U.S. Pat. Off.

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The Plastiscope

pany has printed drapes as far back as 1946.

Why vinyl is big business. The company is a good example of why vinyl is big business. In addition to the usual printed vinyl for shower curtains, garment bags, etc., Velveray has two major products of rapidly increasing volume. One is a vinyl-nylon laminate for outdoor furniture covers, umbrellas, and beach goods; the other is a vinyl-nylon tarpaulin for truck covers, agricultural uses such as silos, baseball and football field covers . . . almost anywhere that a tarpaulin is desirable. The tarpaulins are now being examined for use as coverings on airplanes or as inflatable hangars to protect planes against icing, could also be used as portable ice skating rink frames. The tarpaulins consist of two 6-mil pieces of vinyl film with a nylon net laminated between them. The tarpaulins are not only a third lighter than canvas, but shed water instead of soaking it up; a baseball diamond tarpaulin of vinyl and nylon can be handled by eight men compared with 17 for canvas. The furniture covers are even lighter—use a 2- or 4-mil film with nylon interlayer.

Announcements concerning possible big volume uses for vinyl have been coming out in a rather steady stream ever since the beginning of the year. They certainly lend encouragement to a belief that vinyl chloride resin volume will go well over 600 million lb.—maybe 650—in 1957 and retain its leadership in sales.

Other new wall coverings. U. S. Plywood Corp. was the first 1957 entrant to announce a new wall covering when the company brought out its Quality Grade Kalistron as a companion to architectural Kalistron which has been on the market for several years, primarily for industrial wall coverings. The latter is clear vinyl with the pigment decoration applied to the back surface and sealed in with a suede-like flock backing. Quality Grade Kalistron, which is of similar construction to architectural grade, was brought out specifically for the home owner. It can be applied for about 50¢ a sq. ft. or about half the cost of the architectural grade.

Armstrong Cork Co., too, has announced several new vinyl items that are expected to add considerable volume to its already considerable poundage of vinyl floor covering. One is a vinyl-asbestos wall tile in 9- by 9-in. size and nine colors; the second is a wall and countertop material which comes in 30- and 42-in. width rolls; the third is a vinyl-cork floor covering.

May reach 100 million lb. The floor coverings, furniture covers, and tarpaulins are already well established. The first may reach 100 million lb. in the not too distant future. The other two can't be expected to reach such heights, but the possibilities for tarpaulins are well up in the millions.

The situation in wall coverings is a little different. Technical and economic problems have held up rapid development of this market, but it may be that the vinyl industry's stepped-up interest in this field is an indication that these problems have been conquered and that wall covering may move ahead as floor coverings did three years ago when similar problems were overcome after a long development period. However, the skeptics still assert that a $35 million market, part of which must be shared with other materials, is no great shakes in an industry as big as vinyl. The market will have to be expanded if it is to be a headliner and the road to expansion will have to be paved with high-quality goods at lower cost.

Metallized plastics expanding into new fields

Vacuum metallizing on plastics has been growing so fast that only those in the business have been aware of its significance. It is a ten-year-old industry but was slow growing until the past year or two. There are now about 250 companies in the business with some 300 units in operation. Most of them vacuum coat both metal and plastics, although there are a very few that work only on specialized applications such as lens coating or selenium rectifiers.

Early growth was held up partly by lack of a suitable lacquer for both under and over coats, but that situation has been corrected. Vinyl lacquers are used for thermoplastics and phenolic lacquers for thermosets and metal. Theoretically, at least, the finished coating is only as good as the top lacquer since the topping must be durable enough to withstand severe service conditions. Proponents claim that vacuum-coated metals with a phenolic lacquer top coat are even more serviceable than chrome plating.

The base broadens. In its early days, vacuum coating on plastics was confined primarily to novelty items and toys; the lacquers then available for top coats were not suitable for heavy duty, but industrial items now make up the larger portion of the business. One lacquer producer alone reportedly sells over $1 million worth a year to the metal coating industry; another, who makes only lacquer for vacuum coating, has developed a quarter million dollar business. The lacquers sell for from $3.75 to $6.50 a gallon.

Another industry that benefits from vacuum coating or metallizing is the tungsten coil producers. Tungsten coils have proved most successful as heating coils for metallizing—each unit requires from 16 to 20 or more such coils and they must be replaced after several hours service. The first advertisement of such coils in MODERN PLASTICS brought in over 150 inquiries.

The cost of installing one metallizing unit runs from $15,000 to $30,000 and the larger plants operate two or three. Ovens used cost from one to several thousand dollars. The lowest cost of a practical total installation is about $22,000, but larger installations run up to $50,000. A few $100,000 installations have been made with automatic lacquering and con-

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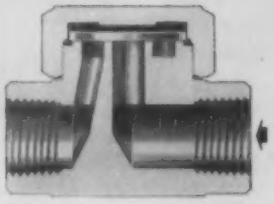

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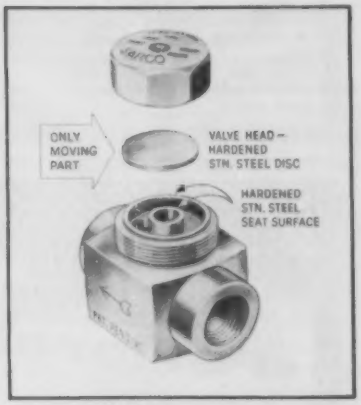

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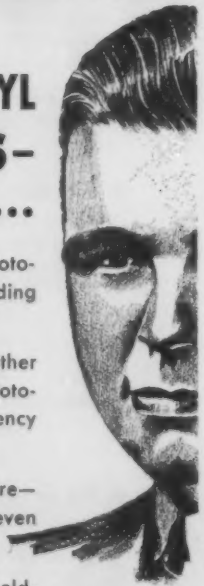

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The Plastiscope

veyor systems. The larger installations are generally operated at a lower per unit cost and consequently can outbid companies with a small installation for most applications.

On many plastics. Most any plastic is suitable for vacuum metallizing according to information from F. J. Stokes Corp., one of the major producers of vacuum metallizing equipment. Mylar polyester film is one of the easiest to handle since it contains no plasticizer; it is being widely used for automotive trim and in other places where not only its beauty but heat reflection are advantageous. Mylar film has been run in a continuous metallizing process as fast as 500 ft./min. in widths up to 54 inches.

Cellulose acetate is more difficult to handle since volatile vapors from the plasticizer must be coped with; but it was perhaps the first plastic to be successfully handled in a metallizing operation and the film is now widely used for Christmas wrappings. Sequins made from metallized acetate sheet are big volume business, and coated acetate threads are used in metallic-type textiles. Polyethylene presents difficulties since lacquers fail to adhere to its waxy surface, but this problem is soon expected to be solved.

One of the oldest uses of metallizing is on the second surface of methacrylate, now common in appliance and automobile name plates and medallions. This method has grown rapidly since the late forties and is now in use on automobile exterior trim to simulate chrome plating. A Detroit concern is now stocking metallized methacrylate sheet for sale in small quantity lots.

On closures. A newer application is that of metallizing thermoset closures to give them a colorful appeal to meet the growing competition from thermoplastic closures. At least three molders are now set up for metallizing phenolic closures. Knobs for ranges and television sets are also a big possibility. Experiments are now being carried on to metallize styrene impact sheet. Molded polystyrene novelties were among the first to receive the treatment. Dressing up polyester reinforced panels with a metallic coating also offers intriguing possibilities.

The 1957 Ford contains seven metallized plastics parts, including the center medallion in the steering wheel, the tail light, back-up light trim, and a lid that fits into the dashboard to cover the heater control. Part of the metallizing is done right in the Ford plant.

Another interesting development is the adoption of vacuum metallizing to printed circuitry to establish a conductive coating on the phenolic base.

How the business is distributed. The total dollar volume of custom metallizers today is estimated to be divided as follows: novelties and toys, 40%; closures, 20%; decorative medallions, 30%; and miscellaneous, 10 percent. The largest future growth is expected in such applications as molded automotive parts to simulate chrome, reflectors for flashlights and photo flash guns, kitchen cabinet hardware, poles used for window curtains, and street light reflectors. A metallized toilet seat to match the chrome hardware of a bathroom is a possibility. Methacrylate faucet hardware with a metallized second surface, and metallized horns and headlight cases for bicycles are all in production. Metallized steering wheels are possibilities that may be considered. Because of the reflective heat insulation value added by metallizing, a methacrylate fire fighter's mask with a metallized coating is another possibility. All of these possibilities, of course, consider use of plastics as the base material.

Growth of this industry is such that members are now forming a trade association for the purpose of advancing knowledge in the field. T. J. LaBounty of Logo, Inc., 12933 S. Stony Island Ave., Chicago, Ill., is temporary chairman of the group that is getting together to form a program for the proposed association.

Monsanto adds to its petrochemicals field

Much has been made of the big petroleum companies' entry into chemicals, but it is interesting to note that the chemical companies have no intention of permitting a "take-over." They in turn are enlarging their holdings in petrochemicals. Note Monsanto, for example. Purchase of Lion Oil was its first big move. Now it has been announced that Monsanto Chemicals, Ltd., a British subsidiary, has begun work at a 100-acre site adjacent to an Esso refinery near Southampton where polyethylene, acrylonitrile, and copolymers of the latter will be produced. Neither of the latter two have been available from United Kingdom production.

Monsanto has also announced its first oil production in Canada from a well in Saskatchewan and a new discovery well in Lafayette Parish, La.

Spray finishes offered

Sprayable plastisol compounds in a range of specifications have been announced by Auburn Button Works, Inc., Chemical Processing Div., Auburn, N. Y., under the names of Flintlok and Tufkote.

Flintlok 40 is applied to any metal surface without need for a primer undercoat, and presents a flinty, abrasion-resistant surface; Flintlok 41 has the same characteristics but includes a suspension of fine metallic flakes to give a silver or gold glitter effect; Flintlok 42, also identical to No. 40, comes in metallic lusters and opalescent sheens of any hue. The Flintloks are said to have a 95 Durometer hardness on the C scale; not to scratch, chip, crack, or peel; and to have high chemical resistance. They are suggested for application to interiors of storage tanks and processing equipment subject to corrosion, to shop machinery and many types of industrial apparatus, to appliances, office machines and equipment, carrying cases, metal furniture,

The Plastiscope

toys, vehicles, farm machinery, and all metal products.

Tufkote plastisol sprays provide a thicker, more cushiony coat in a variety of textures ranging from shiny or satin surfaces to pebble, wrinkle, or leather grain. Tufkotes are said to fill and cover rough metal surfaces, often eliminating or reducing the need for grinding and polishing operations on castings and forgings. Tufkotes are non-volatile. Tufkote 22, 23, and 24 are 90 to 95% solids. Tufkote 20 and 21 contain 100% solids and can be applied in one operation in wrinkle or texture finish in thicknesses up to 0.070 in. without sag or pin holes. This, according to Auburn, results in savings since hardly any material is lost in fumes.

Rohm & Haas' annual statement

Net sales for Rohm & Haas Co. in 1956 were $164 million—10 years ago it was $48 million. Net income has grown from $4.7 million to $16 million in that same period. Construction expenditures in 1956 were $24.5 million—the highest previous year was $13.6 million in 1951.

The increase in sales from $162 million in 1955 was achieved despite a decrease of 4.3% from the preceding year in the weighted average selling price of products in 1956. Price reductions were made on Plexiglas and other acrylics, but the market was expanded. Sales of acrylic emulsions for water-base paints increased significantly and they are now being used for paper coatings and automotive fabric backings, as well as for paint.

The largest new construction project is at Houston, Texas, for the manufacture of acetylene, ammonia, and methanol. It is expected that these facilities will help reduce raw material costs for acrylics. Other expenditures were made for new capacity at Houston for production of acrylates and methacrylates. Other projects completed in 1956 were facilities for the manufacture of polyester and other resins at Knoxville, new laboratories at Bristol, and a warehouse and office building in the Chicago area. Construction expenditures in 1957 are scheduled to reach a record high total of approximately $36 million.

In-plant foaming possible

A two-component liquid system of polyesters and isocyanates which reacts at room temperatures in a matter of minutes to result in flexible polyurethane foam is now available from The Dayton Rubber Co., Dayton, Ohio. Flexible foams so produced have densities of 3 to 4 lb./cu. foot.

Heretofore, the company's formulations were available only for foamed-in-place rigid materials, such as encasements for the electronics and other industries. The new formulation is suggested for in-plant foaming of shoulder pads, dashboard pads, toys, baby bumpers, special shipping containers, insulating materials for clothing, home furnishings, etc.

The firm states that no special equipment is necessary other than a scale, mixing vessels, molds, and an exhaust fan.

Stabilizer line expanded

Three new Advastab vinyl stabilizers—CZ-11, BZ-51, and BC-30—are being offered by Advance Solvents & Chemical, Div. of Carlisle Chemical Works, Inc., New Brunswick, N. J.:

CZ-11 is a fluid paste containing U. S. Food and Drug Administration-approved non-toxic compounds of calcium and zinc; its principal use is in calendering, plastisol molding, and extrusion where non-toxicity is the prime requisite.

BZ-51 is a liquid barium-zinc compound combining auxiliary stabilizers; it is said to impart complete freedom from hydrogen sulfide staining and to be especially effective with phosphate plasticizers and heavily filled and pigmented compositions.

BC-30, a liquid barium-cadmium compound combining auxiliary stabilizers, including small amounts of zinc, is a general-purpose system for all types of processing where lubrication is not desired.

Plastics in Jamaica

Jamaica has evidently learned from Puerto Rico and is apparently going out after new industrial establishments for itself. Plastics manufacturers in particular now need only obtain Government approval under the Industrial Incentives Law, which Jamaicans claim will make their island "one of the most profitable areas in the world for establishing manufacturing facilities." A number of molders and laminators have already sought product approval.

Information may be obtained from John Moynahan & Associates, 380 Madison Ave., New York, N. Y.

From leprosy to laminates

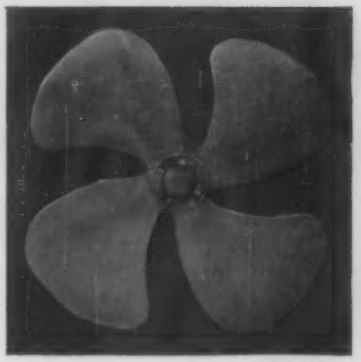
A chemical compound effective in the treatment of leprosy has now been found to be a good curing agent for epoxy resins as well, according to an announcement by Merck & Co., Inc., Chemical Div., Rahway, N. J. This chemical, 4,4'-diaminodiphenylsulfone, or DDS for short, is said to improve the high-temperature performance and electrical characteristics of epoxy resins cured with it.

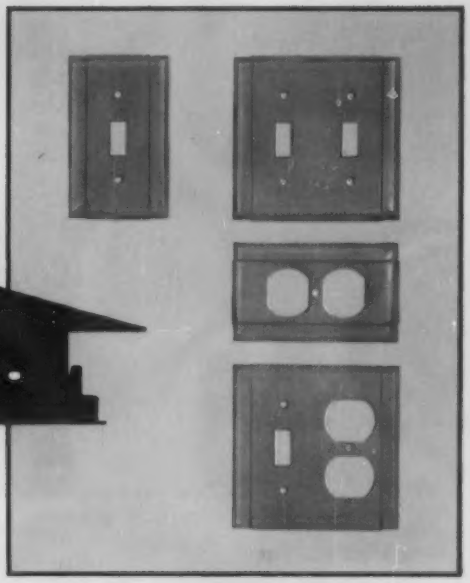
At present DDS is available from Merck in developmental quantities only, but plans are underway for expanding production capacity. For the time being, sales will be handled through the Market Development Dept. in Rahway.

Technical service facilities

The West Coast's first plastics technical service and development center has been opened by The Dow Chemical Co. in Torrence, Calif. The company now has PTS laboratories at Midland, Mich., Allyn's Point, Conn., and Freeport, Texas. Each adjoins a production plant.

In the last 10 years, the PTS organization, coordinated at Mid-





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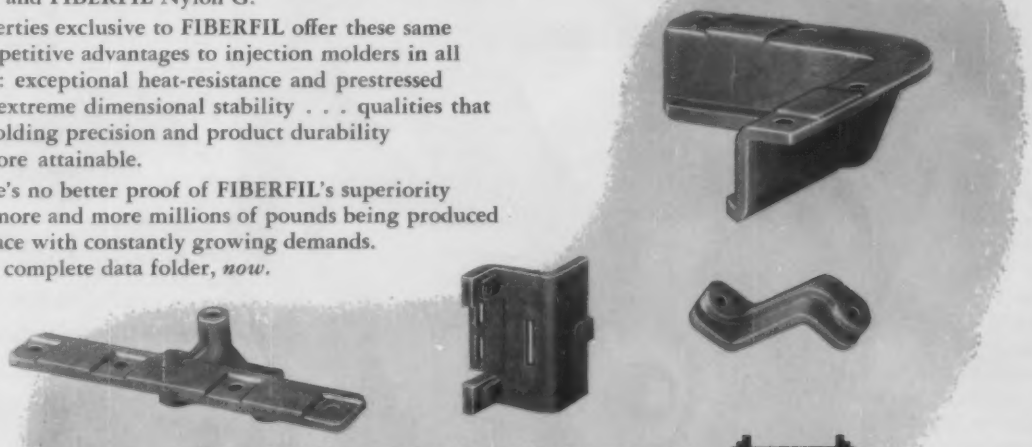

Unseen, but all-important to product quality, are components like these mullion and corner gussets and strike mounting plate — all molded of reinforced FIBERFIL to insure exceptional structural strength and durability.

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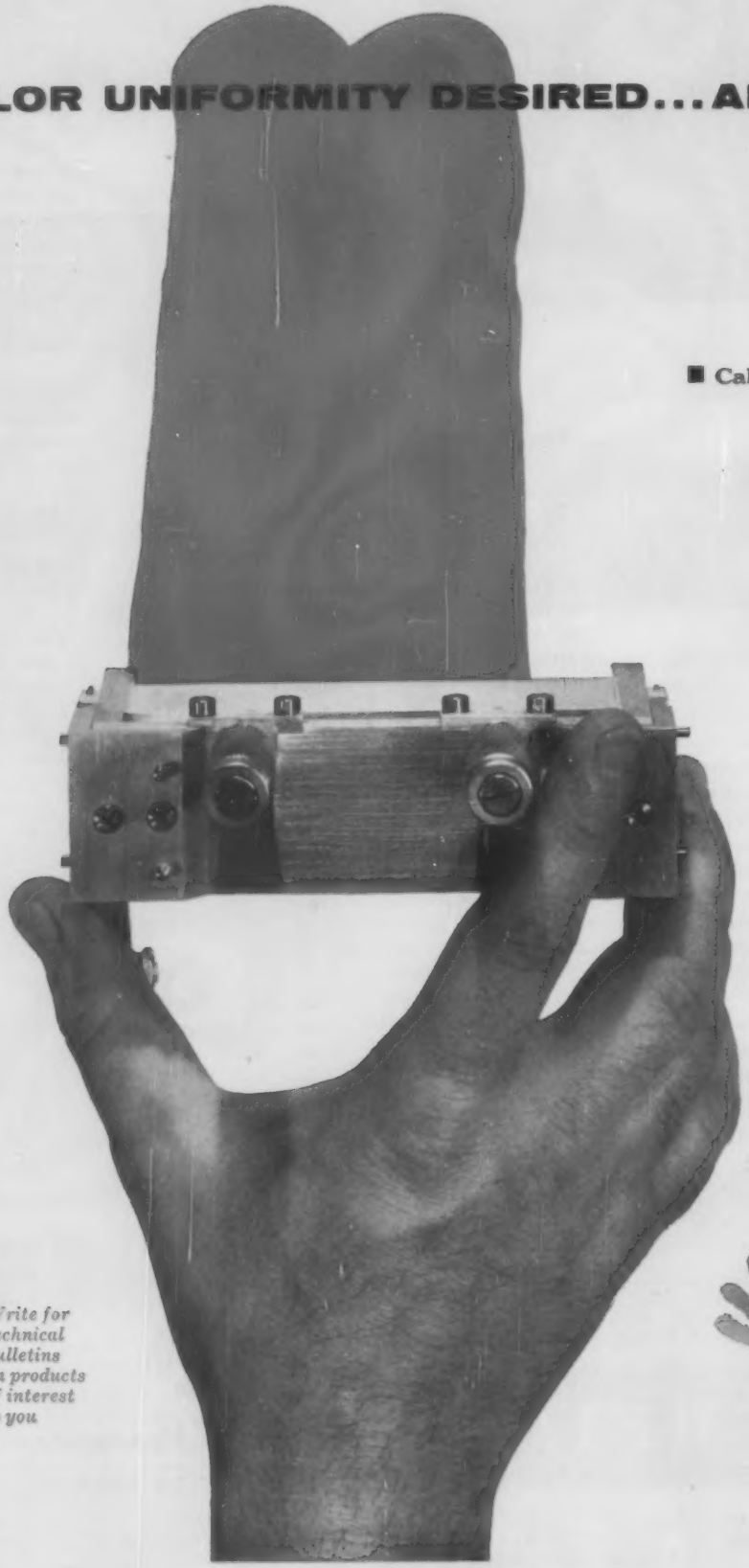

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land, has grown more than 10 times in size. It now has more than 100 technical employees. The work involves such things as helping design new facilities, a new plastic mold, or a new plastic component; advice on use of equipment developed by Dow, such as plug assist sheet forming; consultation on the best plastic to use for a specified job; and instruction courses right in the molder's plant for production people and supervisors.

Polyethylene-wax blends facilitate molding

Blending of Paraflint, a hard hydrocarbon wax, with polyethylene results in a molding compound with a substantially higher melt index than that of polyethylene alone, according to Moore & Munger, 33 Rector St., New York, N. Y., sole U. S. and Canadian distributors of the wax. Both high- and low-pressure-processed polyethylenes can be thus blended.

Addition of the wax is also claimed to improve the feel, gloss, and stiffness of the finished product, an important consideration for thin-walled containers. Impact and tensile qualities are said not to be impaired.

Melting point of the wax is 215° F. compared with 150° F. for conventional paraffin waxes. Also, it has a low viscosity and crystalline structure.

Stabilizer for all PVC resins

A sulfur-free, all-purpose organo-tin light and heat stabilizer, Thermolite 25, has been introduced by Metal & Thermit Corp., Rahway, N. J. It is said to be effective with every polyvinyl chloride and copolymer resin now commercially available.

According to the company, vinyl products stabilized with Thermolite 25 possess good optical clarity and do not cross-stain when placed against vinyls stabilized with lead or cadmium. Printability and heat-sealing characteristics are reported to be good. The firm asserts that Thermolite 25 is efficient in all ratios in the production of rigid vinyls, flexible films, plastisols, and organosols.

Vinyl-metal bonds facilitated

Two adhesive products developed by Compo Chemical Co., Waltham, Mass., are expected by that company to provide a stimulus to pre-finished metal markets.

One, a cement, adheres semi-rigid vinyl to a wide range of metal and other materials and is claimed to result in bonds which can be broken only by tearing the vinyl. The cement may be applied to the metal by roller coat, spray, brush, or dip and the resulting laminate can be deep drawn, punched, cut, drilled, or crimped with no separation of the plies.

The other, a primer, is reported to improve plastisol- and organosol-metal bonds. Conventional methods of application can be used either with a pre-bake of the primer or with only normal drying before coating. The bond is said to allow all tooling operations.

Stabilizes plastisols

Original viscosity characteristics of vinyl chloride plastisols can now be maintained over extended periods through the use of VS-1, a special-purpose viscosity stabilizer developed by Camros Chemical Co., Newark, N. J. The firm states that only 3 to 5 parts per hundred parts of resin are required for effective control.

Cost is 45¢ per lb. in 350-lb. drums; this cost is absorbed to the extent that the total amount of finished plastisol is increased by the amount of VS-1 used.

S.P.I. Midwest Plastics Conference

A two-day Midwest Plastics Conference, combining a business meeting with golf and other recreational activities, will be held at the Arlington Hotel, Hot Springs National Park, Ark., on June 13 and 14 under the sponsorship of the Midwest Chapter, The Society of the Plastics Industry, Inc.

"How to exist in today's market" has been selected as the theme of the meeting. Aimed principally at management level, topics to be covered will include the outlook for the national economy, handling of accounts receivable, inventory and related problems, administration of the sales department, and management problems relating to personnel.

Conference sessions will be held from 9:30 A.M. until noon on both days, followed by golf in the afternoon. Registration has been set at $15 for S.P.I. and S.P.E. members and $20 for nonmembers.

General chairman of the Midwest Plastics Conference is R. L. Davidson, Kurz-Kasch, Inc., Dayton, Ohio; he will be assisted by Elmer E. Mills, Chicago plastics consultant, as vice chairman.

Plastic fluors for nuclear instruments

Solid solution plastic fluors for use in scintillation counters are offered commercially in hitherto unavailable size ranges and shapes by Cadillac Plastic & Chemical Co., 15111 Second Ave., Detroit, Mich. The Cadco fluor is a cast alloy of polystyrene with small percentages of *p*-terphenyl and tetraphenylbutadiene.

The fluors are available in rod form in diameters from 3 to 18 in. and in lengths up to 3 feet. In the development stage are even larger castings of 24- by 48-in. size. Castings are also available to special shapes.

The availability of the larger-diameter fluors is expected to increase the usability of scintillation counters in very-high-energy nuclear physics; measurement of total energy loss by very energetic particles; cosmic ray measurements; biophysical measurements; weapons-test applications; and aerial-survey mapping of ore deposits.

In addition to good scintillation characteristics, the fluors are said to be superior to the commonly used crystal phosphors in hard-

The Plastiscope

ness, machinability, and chemical stability. They have minimal water absorption and meet high standards of chemical purity.

More polyether-based resins

A new series of polyether-based resins for making urethane foam is now offered in commercial quantities by Isocyanate Products, Inc., Wilmington, Del. Designated Isofoam L and especially designed to meet requirements in the cushioning field, these new formulations are said to offer low compression set, good aging and chemical resistance, high resilience, and low cost. Slit stock is also obtainable from several slab stock suppliers.

Epoxies mend concrete

Eroded concrete can be effectively patched and protected through the use of Epocast epoxy resins, according to information from Furane Plastics, Inc., 4516 Brazil St., Los Angeles, Calif. After cracks have been filled and fillets applied to corners, the entire area to be protected is coated. Various formulations are required for the different operations.

More items Sanitized

Use of Sanitized chemicals has been extended to its line of inflatable toys and plastic dishes by Ideal Toy Corp., New York, N. Y. The company had previously announced use of the bacteriostatic additives in its line of plush toys.

Contact adhesive for mass production laminating

Designed for industrial bonding operations on high-speed production schedules, fast-setting Hybond 56 contact adhesives produced by Pierce & Stevens Chemical Corp., Buffalo, N. Y., is suggested for most types of dissimilar lamination involving plastics laminates, fibreboards, leathers, wood, fabric, rubber, honeycomb, steel, and aluminum. According to the manufacturer, Hybond 56 produces an odorless, non-staining bond having high dead-load strength but sufficient elasticity to resist shock and fatigues.

Applications include laminating counter, desk, and table tops; paper-honeycomb; curtain-walls, and other products.

Hybond 56 is available in natural (tan), red, and blue, the latter two for convenience in determining the amount applied.

Group studies polyethylene coating

A division of Specialty Paper and Board Affiliates, Inc., called Polyethylene Extrusion Coaters Group, held its annual meeting in New York City recently. At the same time, C. W. Hoffman, Riegel Paper Corp., was elected chairman and John D. Johnson, Union-Bag Camp Paper Corp., vice chairman. The Executive Committee is headed by Guy E. McCorison, Thilmany Pulp & Paper Co.

The group is now composed of 17 companies concerned with polyethylene extrusion coating. Charles A. Southwick, Jr., technical editor of MODERN PACKAGING, addressed the meeting on the subject of polyethylene extrusion coating, with particular reference to the development of new kinds of resins and its prospective effect on the industry.

Sun Rubber anniversary

Sun Rubber Co., Barberton, Ohio, is observing its 34th anniversary. The company's first big sale in 1923 was 1 million toy hot water bottles to Woolworth's. It is now one of the leading producers of vinyl and rubber dolls, toys, playthings, and athletic balls. The line consists of 100 products. T. W. Smith, Jr., president since the firm was organized, has twice been president of the Toy Manufacturers Association.

Sun Rubber has long been noted as an early pioneer in the successful adoption of plastisol molding techniques for dolls, balls, and other products under its own patents and claims to be the first producer of vinyl foam sponge trim pads and arm rests for the automotive industry. The Sun hollow-mold process for vinyl revolutionized the process of making hollow shapes. The company is an excellent example of the industrial wedding between rubber and vinyl chloride that has taken place in this country and that will become more and more important as the years roll along.

Cleaner destaticizes

Spac, an all-purpose plastics cleaner claimed to have prolonged anti-static effectiveness, has been developed by S. M. Edison Chemical Co., 2710 South Parkway, Chicago, Ill. The company states that Spac is applicable to all plastics materials, coatings, and fibers and that it will not cause crazing or discoloration, or in any way affect the surface finish.

Suggested uses include application by retail stores to maintain clean, dust-free surfaces on plastic shelves and display items, and by plastics manufacturers to items being shipped to distributors.

Adds Teflon disks to line

In addition to basic Teflon shapes previously carried, Allegheny Plastics, Inc., Coraopolis, Pa., has now introduced a line of standard size Teflon disks. These range from 4 to 18 in. in diameter (in 2-in. increments) and are available from stock in thicknesses of 1/16 and 1/8 inch.

The company states that savings of waste material with disks, through elimination of corners on regular sheet material, amounts to approximately ½ lb. in the case of a 1/8-in. disk 18 in. in diameter versus a 1/8-in. sheet 18 by 18 in. square. This saving amounts to as much as $5.15 per disk, depending upon the poundage bracket involved.

Ferro adds stabilizer

A heat stabilizer for use in rigid and plasticized polyvinyl chloride has been developed by Ferro Chemical Corp., a subsidiary of Ferro Corp., Cleveland, Ohio. Designated Ferro 1827X, the stabilizer is a mixed cadmium-barium-fatty acid soap with or-

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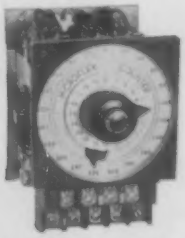

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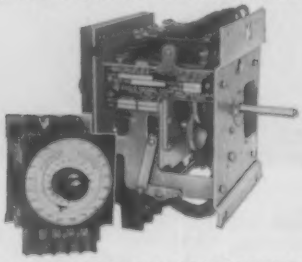

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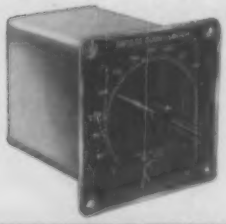
- ACCURATE WITHIN 1 INCREMENT
- TORQUE REQUIREMENTS — 5 INCH OUNCE OR LESS



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ganic inhibitor. The free-flowing powder has an average bulk density of about 4.2 lb. per gallon.

Properties claimed to be imparted to PVC compounds by the new stabilizer include clarity throughout processing; no exudation on long-term exposure to strong sunlight; and long-term stabilization at moderate concentration levels. The stabilization effect is said to be further enhanced by the presence of epoxy plasticizers, or other epoxy additives.

Enters coating field

A new industrial plastics coating firm, Polykote, Inc., 877 Addison Rd., Cleveland, Ohio, has been formed by the purchase of the existing coating facilities of The R. W. Renton & Co. The new company will offer industrial protective coating services in hot and cold dip plastisol, vinyl sheet linings, and epoxy, urethane, and neoprene coatings. Polykote has been assigned as district applicator of Amer-Plate vinyl sheet lining materials manufactured by Amercoat Corp.

James R. Jones, formerly with Claremont Pigment Dispersion Corp. and Ferro Corp., is president. Associated with Mr. Jones are Robert Renton, president of R. W. Renton & Co., and K. M. Keller, president of Keller Products, Inc., Div. of The Macco Chemical Co.

VacForm, VacTrim now made by Emhart

Emhart Mfg. Co., Hartford, Conn., has obtained all rights to the complete line of vacuum forming machinery formerly produced by Vacuum Forming Corp., Port Washington, N. Y., under the names of VacForm and VacTrim. The machines will be manufactured by Emhart's Henry & Wright Div., 760 Windsor St., Hartford.

Included in the VacForm line is the "Giant," reportedly the largest machine of this type in the world (see "Thermoformed Scenery for TV," MODERN PLAS-

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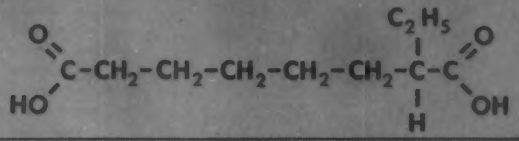
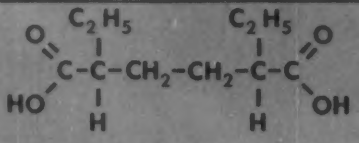
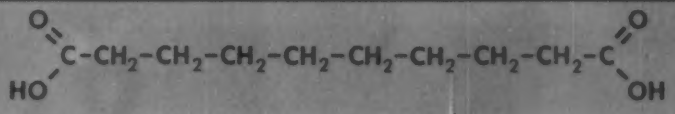


2,5- diethyl adipic acid — 12 to 18%



sebacic acid — 6 to 10%



U.S.I. ISOSEBACIC Acid lowers costs and improves performance when used as an intermediate for:

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(5) alkyd resins — imparts flexibility and water resistance to surface-coating film.

U.S.I. ISOSEBACIC Acid is a mixture of C_{10} dibasic acids which is now offered in pilot plant quantities at a development price of 45¢ a pound. Full-scale production prices will be even lower.

This new intermediate is a white crystalline solid with the following physical and chemical properties:

PHYSICAL PROPERTIES

Molecular weight	202.24
Combining weight	101.12
Density (80°C)	1.025 g/ml 8.55# /gal
Melt viscosity (80°C)	78.5 centipoises
Specific heat of vapor (226°C)	0.34 cal/g (est.)
Heat of vaporization (226°C)	107 cal/g
Specific heat of solid (24°C)	0.33 cal/g
Heat of combination	1296 K cal/mole
Flash point (closed cup)	430°F
Ionization constant at 25°C	$K_1 = 3.5 \times 10^{-5}$ $K_2 = 5.1 \times 10^{-6}$

CHEMICAL PROPERTIES

1. Undergoes typical reactions of the dibasic acids.
2. Reacts with alcohols to yield both acid and neutral esters.
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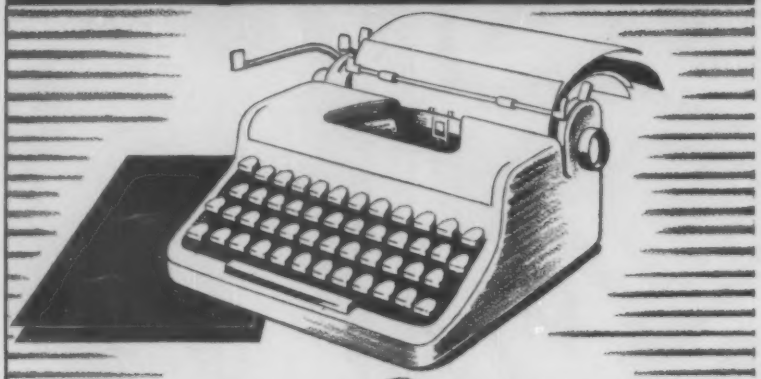

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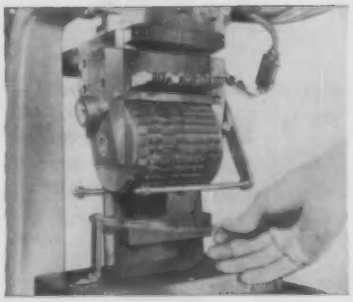

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The Plastiscope

TICS *34*, 100, April 1957), now turning out television scenic elements up to 12 by 6 ft. for the National Broadcasting Co.

Other divisions of Emhart include The V & O Press Co., Hudson, N. Y., which produces presses, automatic feed attachments, etc.; Plax Corp., 50% of which is owned by Emhart; and others.

Koppers helps build another European plant

A contract to provide engineering data and technical assistance in the construction and operation of a styrene monomer plant at Ravenna, Italy, has been awarded by ANIC, Milan, Italy, to Koppers International, C. A., a wholly-owned subsidiary of Koppers Co., Inc. which handles all foreign activities of the parent company.

ANIC will use the styrene monomer in a GR-S synthetic rubber plant now under construction at Ravenna. This will be the third styrene monomer plant in Europe using Koppers' engineering data and technical assistance. The new plant will have an annual rated capacity of 14,000 metric tons.

Polyethylene tubing down

Price reductions from 1.3 to 13¢ per lb. for "special" polyethylene tubing (flat or gusseted) and of 4.5 to 15¢ per lb. for Steripol boilable polyethylene tubing have been announced by Food Film, Inc., Caldwell, N. J. Gages range from ¾ mil up.

Superior awning material

Vinyl-coated Fortisan fabric is now available as an awning material, competitively priced with canvas. Produced by Herculite Protective Fabrics, Inc., Belleville, N. J., and sold under the tradename Herculite Awning, the new material is claimed to retain perfect fit under all temperature extremes. Lightweight, durable, and non-flammable, the fabric can easily be sewn on standard equipment. It has successfully passed tests in marine and arctic environments and is expected to be a strong challenger in the potential $3 billion awning market.

In addition to the standard 31-in. width, Herculite comes in special sizes ranging up to 12 feet. Electronically welded seams are claimed to prevent seam failures.

Offers urethane coating

Low-density polyurethane coating, produced by Magna Coatings & Chemical Corp., 1785 N. Eastern Ave., Los Angeles, Calif., is a two-component system catalyzed for air cure. Designated Laminar X-500, the coating is recommended by the manufacturer for protecting magnesium, aluminum alloys, and other metals (ferrous and non-ferrous) against corrosion; it is also suggested for use on wood and reinforced plastics.

Laminar X-500 is available in a range of colors in gloss, semi-gloss, and flat finish, including green chromate primer.

Corrosion-resistant cement

A silica-filled polyester resin composition called Haveg 7010 is now being produced by Haveg Industries, Inc., Wilmington, Del. Developed for use with brick and tile tank linings and for laying floors and walls in chemical processing areas, this polyester cement is said to resist a wide range of chemicals, including both acids and mild alkalies at high temperatures, concentrated alkalies at room temperature, and oxidizing agents. Recommended service temperatures are up to 265° F.

Haveg 7010 is supplied as a two-component system consisting of liquid resin and free-flowing powder. The powder can be stored almost indefinitely, the resin for more than 6 months.

Equipment newly installed in Haveg's W. Warren, Mass., plant can produce 55,000 lb. of Haveg 7010 per day.

Improved ink for vinyl

A gold ink for printing on vinyl, claimed to have good tarnish and greening resistance, has been developed by Claremont Pigment Dispersion Corp., 39 Powerhouse Rd., Roslyn Heights, N. Y. According to the manufacturer, 1) color change at 80 to 100 Fadeometer hr. is equivalent to that of conventional bronze gold at 20

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hours; 2) the ink is greening resistant on the most troublesome compounds for 72 hr. at 170° F., under 2 p.s.i. pressure; 3) ink removed by Taber Abraser after 30 cycles is equal to that removed from a conventional bronze gold print after only 10 cycles; 4) it is completely crock resistant; and 5) it is as opaque as conventional bronze golds.

The ink is available in three shades. Price is $1.09 per lb. in 5-gal. pails.

Cellulose Research Institute established

Industry and the academic world have joined in establishing the Cellulose Research Institute at the State University of College Forestry at Syracuse University, Syracuse, N. Y.

The director of the new Institute is Dr. J. J. Hermans, Professor of Physical Chemistry and director of the Laboratory for Inorganic and Physical Chemistry at the University of Leiden, Netherlands. Charter member companies are: American Viscose Corp., Philadelphia, Pa.; The Buckeye Cellulose Corp., Memphis, Tenn.; Celanese Corp. of America, New York, N. Y.; and Hercules Powder Co., Inc., Wilmington, Del.

Primary objective of the Institute is to provide a central source of fundamental knowledge which will serve as a basis for industrial development and growth. Its program will be basic research in fundamentals relating to cellulose. All results of research will be published.

Membership in the Institute is open to all companies interested in research on cellulose.

Joins Teflon parade

Cementable Teflon tapes, glass cloth-reinforced as well as unsupported, are now being marketed by Continental-Diamond Fibre Corp., Newark, Del. Produced in widths from ¼ to 12 in. and in thicknesses from 0.002 to 0.060 in., the tapes are available with either one or both surfaces treated for adhesion. The cementable surface is produced by treatment with a sodium-ammonia mixture.

Suggested applications include low-friction and non-sticking chute and hopper linings, packaging machine guides, coil and motor winding insulation, electronic components insulation, non-corrosive linings for chemical containers, duct linings, laboratory work surface coverings, etc.

Expansion

Pro-phy-lac-tic Brush Co. has purchased the former Propper-McCallum plant and adjacent land in Florence, Mass., for expansion of manufacturing operations. In addition to its brush and other plastics molding operations, the firm also produces several lines of melamine dinnerware.

An area of approximately 43,000-sq. ft. will be adapted for storage of raw materials and other active inventories; it is also planned that all packing and shipping operations of tableware will in the future be conducted from this location.

Metal & Thermit Corp. has broken ground for a new $3 million chemical processing plant at Carrollton, Ky. Construction is expected to be completed by December and operations to start in January 1958.

The new plant will initially produce a number of organo-tin chemicals used as stabilizers in vinyl plastics and in other end products. Production of organic compounds of other metals, such as zinc and cadmium, is planned for the future.

Between 35 and 45 people will be employed at the start of operations. Present plans call for increasing the number of employees to about 75 by 1966.

Initial capacity of chemical products will be 2.5 million lb. per year. The company expects to raise this to 7 million by 1966.

General Electric Co. announces plans for construction of a new product and process development laboratory and further expansion of other facilities of the Silicone Products Dept. at Waterford,

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SAMPLE COLORS FOR PLASTICS. Folder describes company's colors for plastics, including vinyl chips and dispersed powders, and polyester, plasticizer color pastes. Contains attractive display of vinyl chips in many colors. Vansul Sales Company. **(E-701)**

VINYL PLASTISOL. Folder describes "Indusol" liquid vinyl plastisol. Discusses use for spread, spray, dip coating, slush molding and rotocasting. Industrial Solvents Chemicals, Inc. **(E-723)**

NYLON MOLDING SERVICE. Illustrated folder describes Indiana company's custom nylon molding service. Discusses engineering, design, and production resources. Engineered Nylon Products, Inc. **(E-724)**

FOAMED PLASTICS RESIN. Technical bulletin describes properties, gives chemical, physical, density data on company's resin which produces a tough, rigid foam. Pelron Corporation. **(E-725)**

PLASTICS PELLETERS. Illustrated folder describes line of multiple knife cutters that pelletize plastics rod at rate of 10 tons an hour. Also illustrates and describes dicer for sheet stock. Taylor, Stiles & Co. **(E-726)**

SYNTHETIC WAXES. 16-page booklet describes line of synthetic waxes used with plastics as an anti-static and anti-tack agent, as a polish and as a mold release. Lists properties and quantities available. Glyco Products. **(E-742)**

Just turn to the Manufacturers' Literature page in this issue (it's printed on heavy paper), circle the numbers corresponding to the booklets you want, fill in the reply postcard, and mail. No postage needed.

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The Plastiscope

N. Y. The laboratory, expected to be ready for occupancy in January 1958, is part of a $3 million capital outlay planned for the Waterford plant during 1957. More than $1 million worth of additional facilities were added or nearly completed during 1956.

Du Pont has started construction of a fifth laboratory building at the company's center for sales service research at Chestnut Run, near Wilmington, Del. The new 81,000-sq. ft. laboratory, to be operated jointly by the Pigments and Electrochemicals Depts., will conduct customer service and development work on titanium, silicon, pigments, sodium, peroxygen, chlorine, vinyl, and related product fields. It will cost approximately $5 million and is expected to be ready for use by the spring of 1958.

The Cryovac Co., Div. of W. R. Grace & Co., Cambridge, Mass., announces that its Canadian company is building a large converting plant in Toronto, Ont., to service the Canadian market. The expansion at Toronto is the first part of an over-all plant modernization and expansion program which the company will embark upon during 1957. The second part of the program calls for a gradual decrease of operations in the company's oldest production unit at Lockport, N. Y. This plant has been servicing the Canadian market with packaging materials.

The firm's present facilities at Simpsonville, S. C., and Cedar Rapids, Iowa, will service the domestic markets formerly supplied by the Lockport plant.

Zenith Plastics Co., a subsidiary of **Minnesota Mining & Mfg. Co.**, announces that work is well under way on new electronic testing facilities which will be used to test reinforced plastics radomes produced by Zenith for the nation's defense aircraft.

More than $200,000 is being spent to construct a new four-story test center, plus a number of testing towers. An additional $100,000 is being invested in new equipment. This is the first major building project undertaken by Zenith since its purchase by 3M last summer.

Operation of the new testing unit will be under the direction of Sam Oleesky, Zenith's chief electronics scientist, and Charles Peach, chief electronics engineer.

Cabot Carbon Co., subsidiary of **Godfrey L. Cabot, Inc.**, Boston, Mass., will construct a new plant at Tuscola, Ill., for the production of Cab-O-Sil, a white silicon oxide pigment. The new structure will be located on a 75-acre tract recently purchased by the company.

Raw materials used in the production of Cab-O-Sil are silicon carbide, chlorine, and hydrogen. Hydrogen for the operations of the new plant will be supplied by **U. S. Industrial Chemical Co.** and hydrochloric acid, a by-product in the production of Cab-O-Sil, will be sold to **National Petro-Chemical Corp.**

Cab-O-Sil is now produced exclusively for Cabot by **Degussa**, of Germany, for the North American trade, but high demand in the United States led to the decision to construct an American plant.

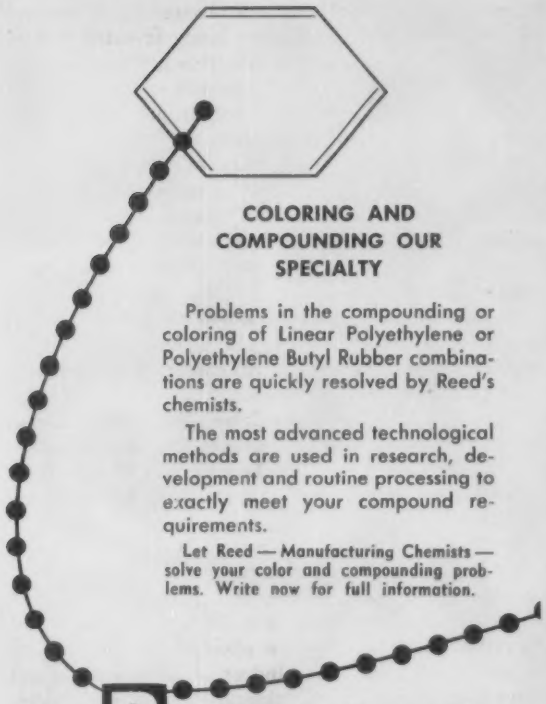
The facility, which will have a capacity of about 100 carloads per year, will be so designed that, with minor changes, other metallic oxides can also be manufactured.

Cab-O-Sil is used in reinforcing plastics and rubbers and in a number of other industrial applications.

Edward J. Holland, Jr., with the company 12 years, most of that time in the White Pigment Div., will be manager of the new operations. The plant will employ about 50 people.

Naugatuck Chemicals, Div. of Dominion Rubber Co., Ltd., will begin construction of a new plant to produce Vibrin polyester resins at Elmira, Ont. The new unit is expected to be in operation in early 1958.

The new structure will represent an additional investment of $500,000 and will be designed to produce a variety of basic poly-



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ester resins, formulations, and premix compounds of all types, as well as alkyds for polyurethane production. Annual capacity will be several million pounds.

A new development and control laboratory to quadruple existing facilities, started last year at the Elmira location, is now nearing completion.

Plastic Horizons, Inc. announces the acquisition of **Raritan Plastics Corp.**, 133 Lincoln Blvd., Bound Brook, N. J. Raritan will continue to operate under its own name as a wholly-owned subsidiary of Plastic Horizons.

As a result, the parent company now offers formable sheet in all widths up to 52 in. and in thicknesses up to 0.125 in., in addition to its polyethylene film.

The company also announces the acquisition of additional manufacturing facilities at 1 Erie St., Paterson, N. J.

Monsanto Chemical Co. announces that a major expansion in production capacity for phthalic anhydride has been completed and is in operation at Everett, Mass., which increases the plant's production by 60 percent.

Emery Industries Inc. has formed a wholly-owned subsidiary **Emery Industries (Canada) Ltd.** The new company will acquire the land, buildings, manufacturing facilities, and existing fatty acid business of **S. F. Lawrason & Co., Ltd.**, London, Ont., producer of fatty acids in Canada for over 75 years.

R. T. Hull, associated with Emery for many years in sales, product management, and sales management, has been appointed vice president and general manager of Emery Industries (Canada) Ltd.

Narmco Mfg. Co. has started construction on a 20,000-sq. ft. plant addition that will increase manufacturing capacity by more than 20% at the La Mesa, Calif., facility. Following completion of

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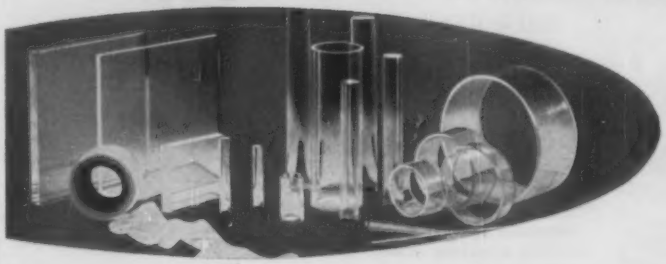

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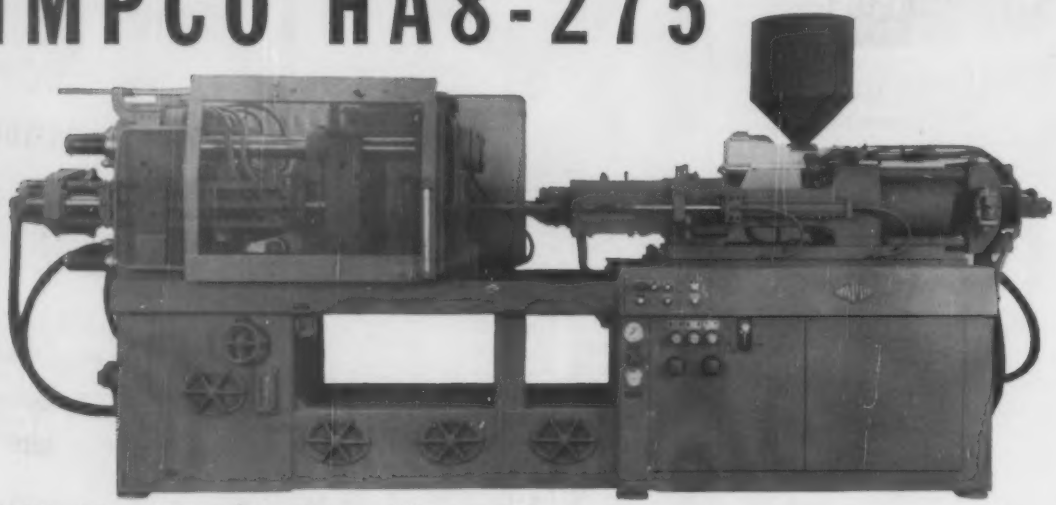

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The Plastiscope

the new La Mesa facilities, Narmco will discontinue manufacturing operations at its original plant at San Diego, which it has occupied since 1946.

Crown Zellerbach Corp. has purchased property near the St. Louis airport for a projected multi-million dollar plant to make flexible packaging materials. The plant under consideration would be part of the firm's **Western-Waxide Specialty Packaging Div.** which operates plants in St. Louis, Kansas City, San Leandro (Calif.), Los Angeles, and Portland. It would replace the present St. Louis plant.

Frank W. Egan & Co., manufacturer of plastics processing equipment and paper converting machinery, announces plans to double the size of its Somerville, N. J., plant by the addition of a 16,000-sq. ft. wing. Construction is expected to be completed by late summer.

The company was located in Bound Brook, N. J., until April 1955, when operations were transferred to the new Somerville facilities.

Southern Plastic Mold, Inc. has moved from Bellflower, Calif., to its new 5120-sq. ft. plant at Anaheim, Calif., which more than doubles the previous space. Added equipment includes a Deckel KFI duplicator, complete with all attachments, including reverse image; new vertical mills and grinders; and modern inspection facilities.

Lester-Phoenix, Inc. has opened an auxiliary plant in Cleveland, Ohio, for machining components for Lester injection molding machines and die casting machines.

Finished, inspected parts are delivered to the nearby main plant where they are assembled.

Botany Mills, Inc., Passaic, N. J., has acquired **Horsman Dolls, Inc.**, with headquarters in New York and manufacturing facilities in Trenton, N. J. Horsman, founded in 1865, was one of the pioneers in the use of vinyl plastisols in dolls. It is said to be one of the eight largest firms in the doll industry. **Lawrence Lipson** will continue as president of Horsman.

The current Botany acquisition is the tenth since its expansion program began in 1955. Among its other purchases was **Jos. H. Meyer Bros.**, and associated companies, manufacturers of polyethylene "pop-it" beads.

Houghton Laboratories, Inc., Olean, N. Y., has added substantially to its plant facilities with the recent completion of new buildings. New plant facilities represent a 20% increase in production area.

The company compounds Hysol epoxy resins for electrical and electronic uses, adhesives, sealants, and plastics tooling materials.

Mol-Rez Div., American Petrochemical Corp., Minneapolis, Minn., announces that its new reactor is now in operation for the manufacture of additional quantities of Pleogen polyester resins, increasing the original capacity by 50 drums daily.

Mol-Rez manufactures polyester resins for laminating, molding, and use in preparing polyurethane foams.

Rheinische Olefinwerke G.m.b.H., Wesseling, Germany, announces plans for the construction of an Epikote resin plant with an initial capacity of 2000 tons per year. The new plant is expected to start operations in mid-1958.

The sale of Epikote resins produced at the new facility will be handled by **Deutsche Shell A.G.**, one of the two parent companies of Rheinische Olefinwerke; the other is **Badische**.

W. S. Shamban & Co. has expanded its Culver City, Calif., operation by about 40 percent. At the same time, the company has opened a new plant at Fort Wayne, Ind., to service the midwestern and eastern states.

Both plants produce Kelon Kel-F raw stock and piston ring seals, extruded Teflon profiles, Teflon

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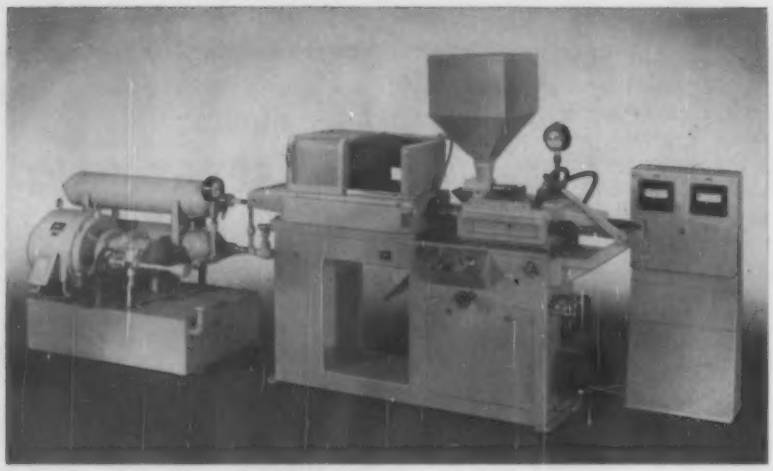

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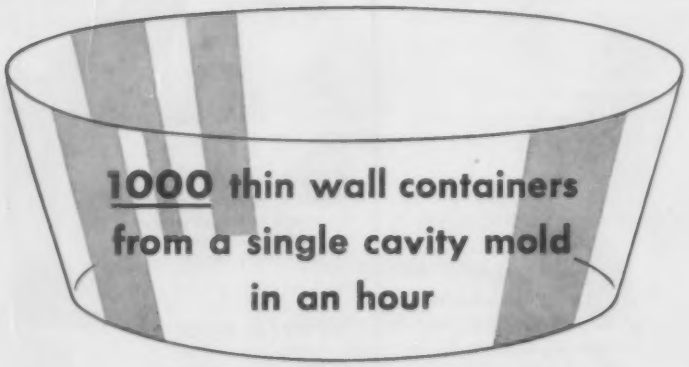

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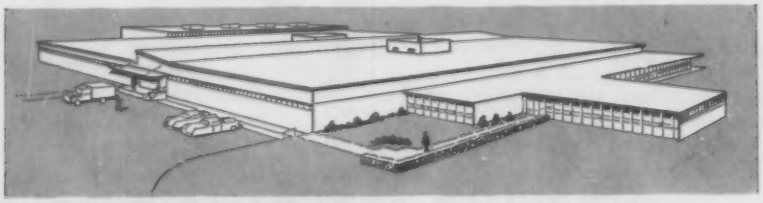

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spaghetti tubing, Califilm fluorocarbon film, Teflon felt, Teflon-coated fabrics, and other fluorocarbon products.

Meetings

Plastics groups

June 13-14: The Society of the Plastics Industry, Inc., Midwest Section Conference, Arlington Hotel, Hot Springs, Ark.

June 14: Society of Plastics Engineers, Inc., Regional Technical Conference, Lowell Institute of Technology, Lowell, Mass. Subject: "Plastics for Electronics."

Other meetings

May 13-14: Commercial Chemical Development Association, Annual Resort Meeting, French Lick, Ind.

May 27-28: Chemical Market Research Association, Hotel Plaza, New York, N. Y. Subject: "Basic Forces for Change in the Chemical Industry."

June 6: Manufacturing Chemists' Association, Inc., Annual Meeting, White Sulphur Springs, W. Va.

June 9-12: American Institute of Chemical Engineers, Meeting, Olympic Hotel, Seattle, Wash.

June 16-21: American Society for Testing Materials, Annual Meeting, Chalfonte-Haddon Hall, Atlantic City, N. J.

June 30-July 3: Housewares Shows Corporation, Second International Housewares Show, Coliseum, New York, N. Y.

July 8-12: National Housewares Manufacturers Association, Exhibit, Atlantic City Auditorium, Atlantic City, N. J.

July 10-20: International British Plastics Exhibition, Grand and National Halls, Olympia, London, England. Additional information may be obtained from John L. Wood, British Plastics Exhibition, Dorset House, Stamford St., London, S.E.1, England.

August 25-28: National Association of Furniture Manufacturers, Third Supply, Equipment, and Fabric Fair and Twenty-ninth Annual Convention, Conrad Hilton Hotel, Chicago, Ill.

Companies . . . People

Henry W. DeVore appointed director of Plaskon plastics and resins sales of **Barrett Div., Allied Chemical & Dye Corp.**, 40 Rector St., New York, N. Y., succeeding **Carleton Ellis, Jr.**, who has resigned. Mr. DeVore started as a factory employee for Plaskon in 1932; in 1945, he was made district manager for molding compound sales in Chicago, and three years later was promoted to product manager for Plaskon molding compounds, the position he held at the time of his promotion.

H. W. DeVore

Union Carbide—Bakelite Co.: E. W. Vaill, with the company since 1932, appointed technical service engineer, Molding Materials Div.; he will serve as technical advisor for phenolic, styrene, and polyethylene plastics on all phases of molding. **A. T. Callas**, named technical representative for the Surface Coatings Div., at the Detroit district office, will handle vinyl, phenolic, epoxy, and polyethylene resin products for surface coatings. **Alfred M. Nissen**, assigned as a technical representative in the Chicago, Ill., district sales office, will be concerned with providing technical assistance to customers using Bakelite molding materials in western Michigan and northern and central east Indiana.

Bound Brook, N. J., plant: New assignments at the Development Laboratories are as follows: **Joseph F. Rocky**, with the firm since 1948 appointed assistant division leader of the Extruded Products Div.; **Ernest E. Griesser**, with the company since 1950, now group leader of the Contour Extrusion Group; **John A. Snyder**, with the company since 1950, named group leader of the Wire and Cable Materials Group.

Silicones Div.: Dr. T. F. Hart, with Union Carbide since 1943 and formerly supervisor of product engineering at Tonawanda, N. Y., named product manager of silicone resins and sizings; **Dr. M. H. Jellinek**, formerly assistant manager of market development, now product manager of silicone specialties; **R. S. Wishart, Jr.**, formerly manager of market development in the midwestern region, promoted to product manager of silicone fluids.

General Electric Co.: L. S. Moody, with the company since 1945, named manager of the New Product Development Lab., Chemical Development Dept., Pittsfield, Mass. **Wyman Goss**, with the company since 1929 and manager of phenolic engineering since 1949, appointed manager of the phenolics product plant operated by the Chemical Materials Dept. at Pittsfield. He succeeds **J. L. Galt**, appointed West Coast marketing manager for the department at Anaheim, Calif. **Richard E. Hoverter** named technical service engineer and **Kenneth W. Raymond** specialist of product development for the Chemical Materials Dept. at the Anaheim plant which produces polyester resins for the plastics industry and Glyptal alkyd resins for the plant industry.

Monsanto Chemical Co.—Plastics Div.: James D. Larkin, formerly with Ethyl Corp., now with the Research Dept. at Springfield, Mass. **Kenneth L. MacIsaac** promoted to assistant district sales manager for New England. **Charles A. Magarian**, with the division for 16 years, named group leader of the industrial resins group, Research Dept., Springfield. **Drs. Lloyd S. Eubanks** and **Lawrence J. Krebaum** have joined the Research Dept. at Texas City, Texas. **Howard A. Tenne, Jr.** promoted to assistant sales manager for raw materials at Texas City.

Hercules Powder Co., Inc.: Dr. Robert W. Cairns, director of research, appointed chairman of the Advisory Panel on General Sciences of the Office of the Assistant Secretary of Defense for Research and Development. Responsibility of the panel will be the development of technical advice and guidance on the basic research program of the Department of Defense in the geophysical, physical, engineering, and biological sciences.

Hawthorn Chemical Corp.: Herbert F. Schaefer, named senior technical representative, will be primarily concerned with sales and marketing. The company, jointly owned by **Hercules** and **I.C.I., Ltd.**, has announced plans for a plant for the production of methyl methacrylate at Louisiana, Mo.

United States Rubber Co.—Naugatuck Chemical Div.: Earle S. Ebers, with the company since 1937 and formerly general sales manager, appointed assistant general manager of the division, succeeding **George R. Vila**, recently named vice president and general manager. **Harold M. Parsekian**, who was assistant general sales manager, now general sales manager. **Gerald L. Dennis**, formerly Los Angeles district manager, appointed manager of field sales. He will supervise the transition of Naugatuck's commodity sales organization to a district sales office

NEW ECONOMY TIP

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Union HONEYCOMB sandwich core is as practical and versatile a material today as plastics themselves. Reason? This expanded cellular paper core, laminated between plastic sheets or "skins", is one of the strongest structures known for a wide variety of applications. And on a square foot basis—the most economical.

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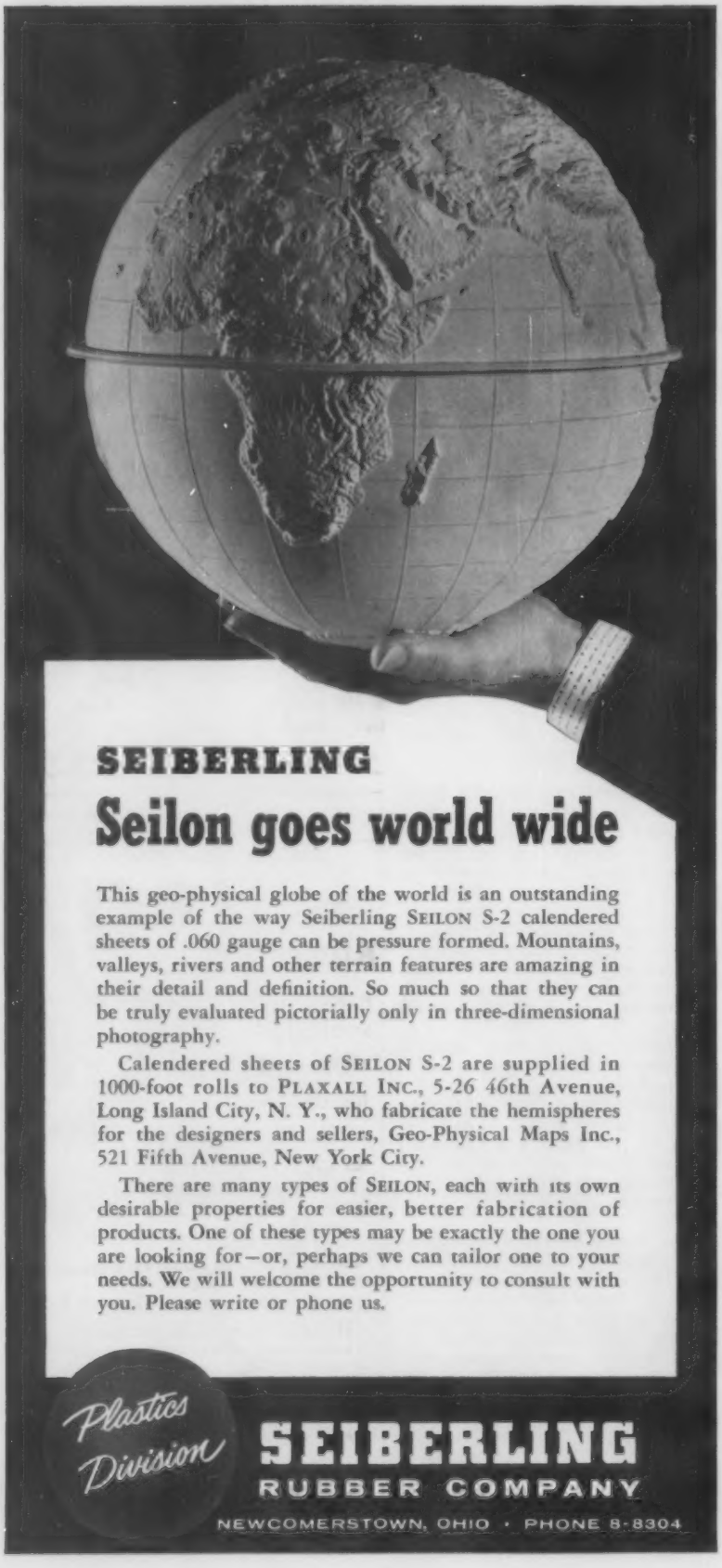
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Companies ... People

set-up and then promote sales of all the chemical division products through this district organization. **David A. Edwards** named plastics technical sales representative in Akron, Ohio.

Footwear and General Products Div.: Edward C. Van Buskirk, with the firm since 1941, appointed development manager; he succeeds **J. Fred Schott** who is on an extended leave of absence. **David D. M. Streed,** with the company since 1942, succeeds Mr. Van Buskirk as assistant development manager of the division.

Spencer Chemical Co.: Edward L. Stevens promoted to works manager of the Orange, Texas, plant; he was also assigned as production superintendent of the Vicksburg, Miss., facility. The Texas plant is devoted exclusively to the production of polyethylene. **Ralph E. Gesell,** formerly a project engineer in Du Pont's Plastics Sales Service Lab., now market analyst for industrial chemicals and plastics products. He will be engaged in market research on polyethylene, nylon, methanol, formaldehyde, and other industrial products.

National Starch Products, Inc.: John D. Beggs, sales manager of the Resin Div., transferred to Los Angeles and will direct activities of the division from there. **Felix Liberti,** supervisor of the Resin Coating Lab. at Plainfield, N. J., will be in charge of paint technical service work as well as long-range paint research. **Paul H. McCormack** now in charge of application engineering for the Structural Products Div.

Filon Plastics Corp., El Segundo, Calif., is conducting a nationwide 4-color advertising campaign to sell its Fiberpane reinforced plastics panels to the consumer, with emphasis on price-consciousness; the material has dropped from $1.39 a sq. ft. in 1951 to 79¢ at present. Filon claims to have sold $3 million worth of the estimated $15 million worth of panels sold in 1956 and expects to sell $5 million worth in 1957.

Two regional warehouses, one in Chicago and the other in New York, have been established, where 1 million sq. ft. of panels will be stocked.

Celanese Corp. of America: Charles W. Proudfit, formerly sales manager of Hormann-Seitz Mfg. Corp., appointed director of sales of the Plastics Div.'s newly created Resin Products Dept.; he will supervise sales of polyester resins and polyvinyl acetate emulsions. Three sales representatives added to the staff of the Plastics Div.: **Kirk E. Smith** for

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ELECTRIC HEATERS of All Types

Voltrap The Complete Contact Insulator

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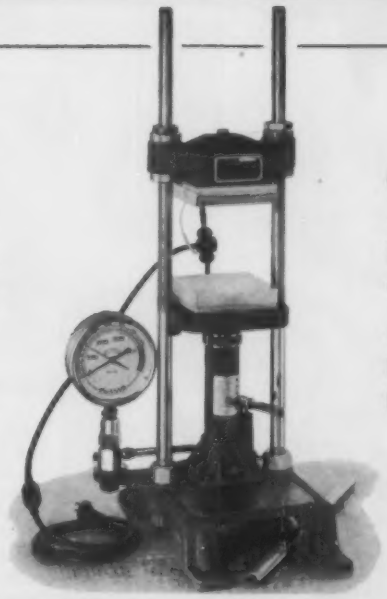
Embossing.
Bonding plywood.
Testing tensile properties.
Testing compressive properties.
Testing shear strength.
Flow tests.
Crushing tests.
Breaking tests.
Determining heat cycles.



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Companies...People

northern California and the northwestern states, **Edward M. Fox** for New England, and **John W. Bloom** for the Midwest.

Keyes Fibre Co.: Ralph H. Cutting, vice president and general manager, elected president, succeeding the late **Wallace E. Parsons.** He was also elected a member of the executive committee. **Douglas Archibald** elected vice president of sales; **Gustave R. Johnson,** vice president of manufacturing; **Walter H. Randall,** vice president of engineering and research. Keyes Fibre produces molded plastic and pulp products.

W. R. Grace & Co.—Dewey and Almy Chemical Co. Div.: James L. Vaughan, previously with National Research Corp., Rohm & Haas Co., and Shell Chemical Corp., appointed assistant research director in charge of process design and development. **Paul W. Hatch** assigned to the sales force of the Organic Chemicals Div.

Phillips Petroleum Co., Bartlesville, Okla., has licensed **Showa Denko K. K.,** Japan, to use the Phillips-developed catalytic process for high-density polyethylenes. Phillips has now licensed its polyolefin process to four major U. S. chemical companies and six leading overseas firms in as many countries.

Koppers Co., Inc., Chemical Div.: Frank R. Garner, manager of the Kobuta, Pa., plant since 1953, transferred to the Pittsburgh general offices on special assignment. **W. K. Todd,** with the company since 1928 and manager of the division's Control Dept., promoted to manager of the Kobuta plant.

The Garlock Packing Co.: Sales forces of Garlock and **United States Gasket Co.,** Camden, N. J., now completely integrated. Garlock acquired the Camden firm in 1955 and the production facilities of both companies were integrated at that time. The present consolidation unites services in the fields of fluorocarbons, nylon, and other plastics offered by USG with the Garlock 2000 line of gaskets, packings, and seals. United States Gasket Co. will be known as **United States Gasket Co., Plastics Div. of The Garlock Packing Co.**

Chicago Molded Products Corp.: John J. Bachner, with the company since 1937 and executive vice president and general manager since 1954, elected president, succeeding the late **Marcel F. Bachner. Louis H. Bachner,** vice president, elected treasurer, an office held by the late Mr. Bachner. Louis H. Bachner is

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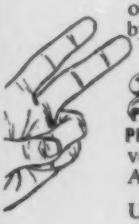
Polycon #40 was developed for use in vinyl flooring, welting, garden hose and other extruded vinyls where slight plasticizer coloration is acceptable. Polycon #40 is also used in coated fabrics, slush and dip moldings, wire and cable coverings.

BROWN-ALLEN Polycon #40's features make it ideal for extrusion compounds. Among these features are:

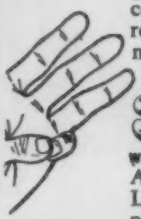
- Superior solvation
- Excellent toleration for low-cost plasticizer extenders
- Gelation and cure rates that help increase production in plastisols
- Greater toleration of filler loads

In addition, BROWN-ALLEN Polycon #40 offers a higher electrical resistivity than DOP by actual test on compounded products.



2 For a low-cost replacement for n-Octyl n-Decyl Phthalates where low temperature and low volatility are desirable, look into BROWN-ALLEN Polycon #5B.

Used in plastisols, BROWN-ALLEN Polycon #5B offers improved flow-out properties, slow gelation and fast cure in addition to low viscosity and excellent viscosity stability. This results in superior definition in complex molds.



3 Whether you buy plasticizers in drums, tank wagons or tank cars, find out about BROWN-ALLEN DOP, DIOP, ODP, DBP and DDP. Like all BROWN-ALLEN products, these plasticizers are precisely uniform, competitively priced and of dependably high quality.

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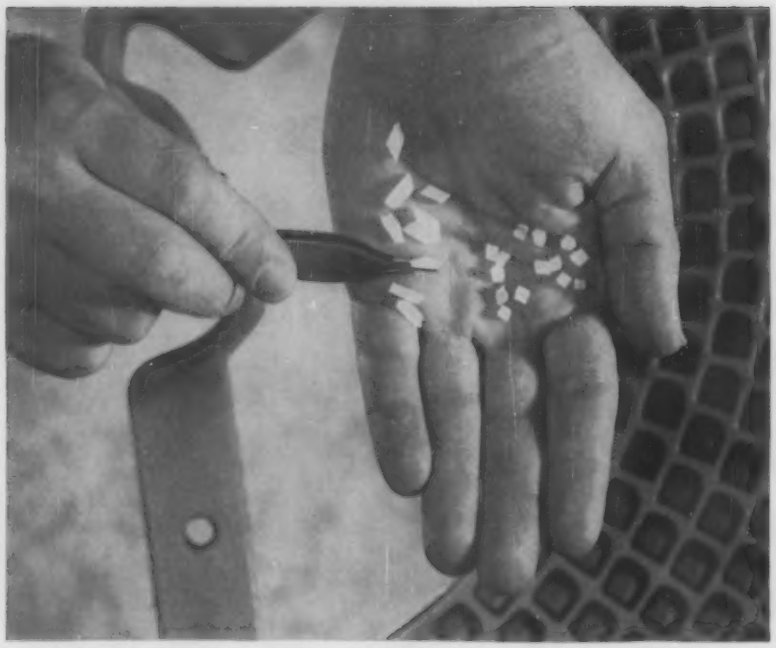

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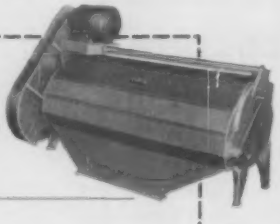

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Companies ... People

one of the original six Bachner brothers who founded the company in 1919.

Harry Davies Molding Co.: Homer Beach, former plant superintendent and a veteran of 25 years with the firm, appointed acting general manager; **Richard Riordan** named assistant to the president; **Robert C. Appleby,** formerly assistant sales manager, now sales manager in charge of all sales and advertising programs; **Edward C. Wright,** formerly in charge of Plant #2, appointed superintendent of molding operations in both plants.

Escambia Chemical Corp.: A. N. Wohlwend, director of commercial development, appointed vice president. **Erhart K. Drechsel,** formerly with American Cyanamid Co., has joined the company and will devote full time to commercial development activities. Escambia produces polyvinyl chloride resins and other chemicals.

Diamond Alkali Co.: James P. Okie, formerly with Olin Mathieson Chemical Corp. and Shell Chemical Co., appointed assistant general manager of the **Plastics Div. Olin Smith,** Chicago assistant branch sales manager, promoted to Philadelphia branch manager, succeeding **C. F. Wolters, Jr.,** who has retired after 37 years with the company. **Robert R. Wood** succeeds Mr. Smith in Chicago.

Baldwin - Lima - Hamilton Corp.—Hamilton Div.: A. V. Wiggins Co., Inc., 334 W. Lafayette St., Syracuse, N. Y., appointed dealer for the Syracuse territory, and **D. Nast Machinery Co.,** 2508 N. Broad St., Philadelphia, Pa., dealer for eastern Pennsylvania, southern New Jersey, and Delaware. Both firms will sell Hamilton mechanical and Baldwin hydraulic and compacting presses, including plastics types.

American Plastics Corp., a subsidiary of **Heyden Newport Chemical Corp.: J. W. Arpin,** formerly vice president of Arpin Products, Inc., named assistant plant manager. **A. T. De Vera,** formerly with Celluplastic Corp., appointed to sales staff.

The Stanley Chemical Co., a subsidiary of **The Stanley Works: Valentine B. Chamberlain, Jr.,** with the firm since 1941, appointed sales manager to succeed **Arthur B. Sherry,** resigned. **Robert T. Kubinak** named Pennsylvania sales representative.

Columbian Carbon International, Inc., 380 Madison Ave., New York, N. Y., is the new name of the firm formerly known as Binney & Smith

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This all-plastic milk float, manufactured by Mickleover Transport Ltd. for United Dairies, employs **deeglas** chopped strand mat as its sole reinforcing material.

All **deeglas** products, chopped strand mat, glass rovings and deeformat, are produced under a quality control system based on the requirements of BS.600 and BS.600R. This ensures the consistency so essential for perfect mouldings.

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Chopped strand mat and deeformat in standard and roof-lighting grades. Glass rovings.

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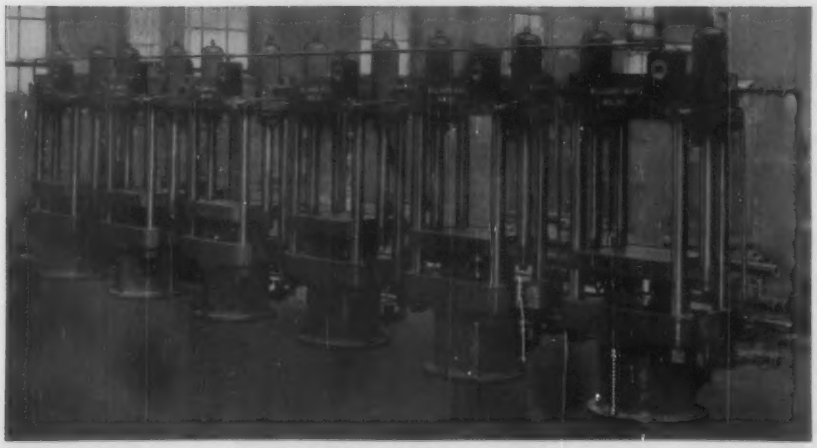

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The hydraulic circuit is so designed that pressure is maintained in five presses while the sixth is opening or closing. Automatic cycle control of each press is by pushbutton and adjustable timer.

This system represents considerable reduction in initial and maintenance costs by eliminating the expensive, space-consuming accumulator while retaining its desirable features.

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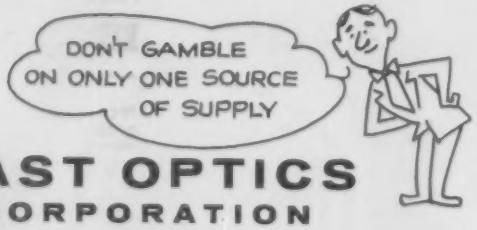

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Manufacturers of COCOR * BRAND Rigid Plastic Sheets

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Companies... People

International, Inc. The company will continue to represent Columbian Carbon Co. abroad in the sale of its carbon black, as well as other American manufacturers.

Olin Mathieson Chemical Corp., Film Div.: James E. Bodie and **Edward T. Behringer** assigned to new districts: Mr. Bodie will cover the Midwest from the Chicago office and Mr. Behringer the far West from the Los Angeles office. The division sells cellophane used mainly for packaging and polyethylene used for packaging and in construction.

Society of Plastics Engineers, Inc., Eastern New England Section: The following officers elected for 1957: president—**David Towler, M. W. Kellogg Co.**; vice president—**William Nissen, Bakelite Corp.**; treasurer—**Robert Ward, Improved Machinery Co.**; and secretary—**George Kovack, Foster-Grant Co.**

NRC Equipment Corp., a subsidiary of **National Research Corp.**, Newton Highlands, Mass., has opened a district sales office at 19185 James Couzens Highway, Detroit, Mich., with **William C. Long** as manager. NRC manufactures vacuum coating machinery.

McCarten Industries, Inc., Laboratory Park, Chagrin Falls, Ohio, has been formed to produce and market Max-Tic, a polyvinyl-based mastic for plastic wall tile. **George C. McCarten**, a chemical engineer and an early pioneer in the wall tile adhesive field, is president of the new firm; **Carl R. Freeman** is vice president.

Standard Tool Co.: John F. Neuman and **Milo Dellmann** appointed to sales staff. Mr. Neuman will cover the Midwest and Mr. Dellmann the West Coast. Standard supplies mold components and other equipment to the plastics and other industries.

Resistoflex Corp.: Southwest Div. formed, with headquarters at Dallas, Texas, to service the southwestern states. **C. C. Cozzens** is manager. A similar division in Burbank, Calif., services the West Coast. The company produces a line of fluorocarbon hose and hose assemblies for aircraft and industrial application.

Taylor Fibre Co.: John M. Taylor, Jr., formerly vice president in charge of the La Verne, Calif., Div., elected president, succeeding **Merrit H. Taylor** who has resigned as president and continues as a director. **H. C. Steadman** elected vice president, Manufacturing; **E. H. DaCosta**, vice president, Marketing; and **C. N.**

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Companies . . . People

Jacobs, vice president, Technical and Engineering. **John M. Taylor, Sr.** continues as chairman of the board. The laminated plastics and vulcanized fibre for industrial use are manufactured by the company at Norristown, Pa., and La Verne.

Popular Plastic Products Corp.: After 12 years of private ownership, the firm now has become a publicly owned corporation. Its primary business is custom injection molding. Recently the company developed a line of clear cellulose acetate covers for electric meters and street lighting controls.

Dewl Plasti-Toy Corp., a wholly owned subsidiary: Licensing agreement tie-ups with Walt Disney Productions and MCA under consideration for use of the Disney name and characters in association with the firm's toy line and for the use of MCA stars in the endorsement of part of a new line. **Mitchell R. Kittay** named general manager.

A. E. Fleming Co., 1900 E. Jefferson Ave., Detroit, Mich., named distributor for **Minerals & Chemicals Corp. of America**, Menlo Park, N. J., will handle the sale of aluminum silicate pigments and attapulgites to the chemical process industries in Michigan and part of northwestern Ohio and northeastern Indiana. Products of M & C are processed into fillers for plastics and other products.

The Joclin Mfg. Co. has moved its factory and offices to Lufbery Ave., Wallingford, Conn. The company is a custom compression and transfer molder.

Garfield Mfg. Co.: Felix Henne appointed general manager; **Gerald H. Howell** re-appointed foreign representative. The firm does compression, transfer, and cold molding on a custom basis.

Mobay Chemical Co. has opened a New York district sales office at 405 Lexington Ave. **L. Dean Tyler**, manager of the eastern sales district, will be in charge of the new quarters.

Service Plastics, Inc., plastics injection molder, has moved from 1118 W. Jackson Blvd. to new quarters at 5333 N. Elston Ave., Chicago, Ill.

Projectile & Engineering Co., Ltd., London, England, has formed an Australian subsidiary, **Peco-Hardie (Pty) Ltd.**, in conjunction with **Hardie Trading, Ltd.**, Australian manufacturer. The new firm will manufacture Peco injection molding machines and extruders in the Commonwealth, with operations based in Melbourne. Hardie Trading has distributed Peco machinery in Australia for some years. **A. L. Beer** will be production manager.

Reynolds Chemical Products Co.: Samuel M. Terry, formerly with Pittsburgh Plate Glass Co., named manager of product development. **Robert C. Askins** appointed plant engineer. The company makes plastisols and organosols, vinyl coatings and dispersions, vinyl and urethane foams, and adhesives.

Howard Supply Co., Oregon sales agency for **Synthane Corp.**, Oaks, Pa., moved to larger quarters at 706 N. Page St., Portland, Ore.

C. D. LaMoree Co. appointed California and Arizona distributor for compounds produced by **The Epoxylite Corp.**, El Monte, Calif. Epoxylite formulates a line of epoxy resin systems varying from elastomeric sealants to rigid potting resins having heat distortion temperatures up to 600° F.

Atlas Pattern, Inc. has moved to new and enlarged quarters at 5050 Bennett Rd., Toledo, Ohio. The firm produces plastics and other models and patterns to specifications.

Carleton Ellis, Jr. has resigned as director of sales of plastics materials of **Barrett Div., Allied Chemical & Dye Corp.** to accept the presidency of **Cavitron Corp.**, Long Island City, N. Y. Cavitron has developed a patented process for cutting hard materials by means of ultrasonics which has been found useful by die makers and other metal workers who use it for cutting hardened steel and similar materials. Mr. Ellis came to Barrett when that company purchased Plaskon where he had served in a similar capacity.

M. M. Suba appointed manager, Extrusion Materials Div. of **Bakelite Co.**, a **Div. of Union Carbide and Carbon Corp.**, succeeding **W. J. Canavan** who is now assistant manager of the New Products Engineering Div.

H. K. Vanderhoef, with the firm since 1943, appointed vice president in charge of sales of **Kay-Fries Chemicals, Inc.**, 180 Madison Ave., New York, N. Y., manufacturer of organic intermediates for the plastics and other industries.

John J. Curry, head of engineering of **Fayette R. Plumb, Inc.**, elected vice president—engineering and a member of the board of directors. Mr. Curry has been with the firm since 1937. During the past two years he directed the research which resulted in the manufacture of reinforced-fibrous glass handles for hammers, hatchets, and other hand tools. Mr. Curry was also in charge of the engineering and development

(*To page* 289)

ANCHOR PLASTICS CO. INC.

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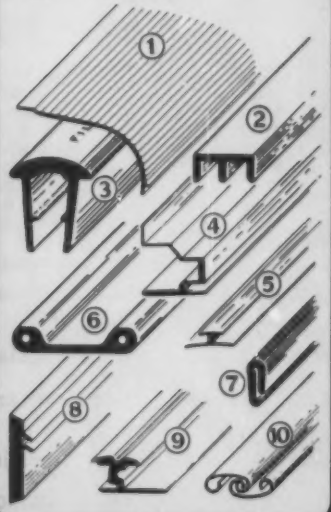
Some new applications for precision extruded SHAPES are: 1) Freezer Light Cover; 2) Sliding Door Tracks; 3) Air Conditioner Filter Holder; 4) Rail Coach Shade Guide; 5) Wall-panel Joint; 6) Manometer Body Tube; 7) Rotary Index Handle; 8) Name Plate Holder; 9) TV Cabinet Moulding; 10) Tambour Door Extrusion. You can get a more detailed description by reading our brochure EXTRUDED PLASTICS.



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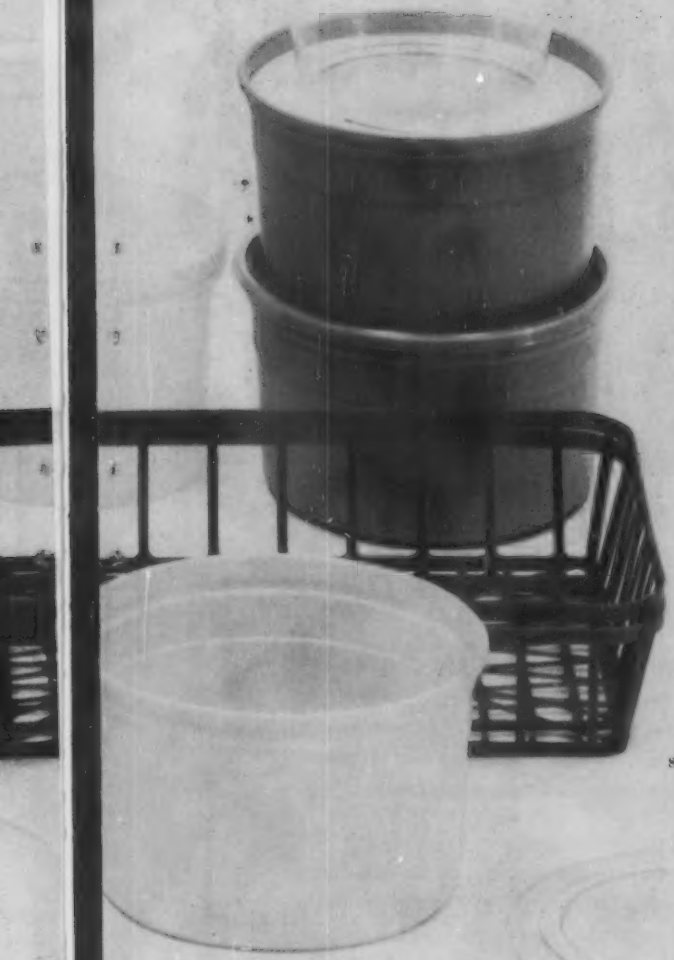

New Lustrex LHA . . . medium impact formulation with superior translucency for good product visibility . . . excellent surface finish.

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YOUR BEST CANCER INSURANCE is (1) to see your doctor *every year* for a thorough checkup, no matter how *well* you may feel (2) to see your doctor *immediately* at the first sign of any one of the 7 danger signals that may mean cancer.

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American Cancer Society

project which brought about the discovery of Permabond, a chemical weld which makes it possible to eliminate the use of wedges in assembling hammers and other hand tools.

Wayne E. Brooks, formerly with The General Tire & Rubber Co., appointed sales manager of **Molded Fiber Glass Co.**, Ashtabula, Ohio; he will be in charge of sales of reinforced plastics parts custom molded by the company.

Otto Kaufholz, chief executive of **Hermann Berstorff Maschinenbau-Anstalt G.m.b.H.**, Hannover, Germany, builder of machinery for the plastics and rubber industries, celebrated his 50th anniversary with the firm in April 1957. Technical and mechanical ideas introduced by Mr. Kaufholz have made made him well known among manufacturers of machinery for the plastics and rubber industries, both in Germany and in other countries. He was once president of the Board of the VDMA (Association of German Machine Manufacturers) for Lower Saxony.

O. Kaufholz

Bjorksten Research Laboratories: James E. Henning appointed vice president and **Irvin Leichtle** administrative assistant. Bjorksten conducts sponsored industrial research and economic surveys in plastics and other fields.

John G. Hixson named manager of technical services of the **Rochester Div., Consolidated Electrodynamics Corp.**, Pasadena, Calif. The firm is active in the field of vacuum metallizing.

Earl Noblet appointed assistant manager of market development of **Sinclair Chemicals, Inc.**, 600 Fifth Ave., New York, N. Y.

J. D. Proctor, general sales manager of **Celluplastic Corp.**, Newark, N. J., elected a vice president. The company makes plastics jars, vials, and custom plastics packages.

J. C. Findlan promoted to sales manager of **Geigy Industrial Chemical Div., Geigy Chemical Corp.**, Ardsley, N. Y. The firm markets an additive said to mask yellowing in plastics.

Leonard A. Britzke, vice president and general manager since the firm was purchased by **American Can Co.** last year, elected president of **Bradley Container Corp.**; he was

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Here are the LOW-COST answers to YOUR labeling problems!

whatever you need... AVERY LABELING will save you time and money

See the difference with

Avery pressure-sensitive Labeling offers you a new approach . . . an easier and *better* solution . . . wherever you need to code, identify, instruct, warn, route or inspect. It's the modern low-cost method of labeling to do the job quickly and efficiently. Avery Labels can be designed and produced in the exact size, shape and color you need . . . individually die-cut on sheets or rolls for manual or automatic labeling!

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One simple motion—a fingertip pressure—and Avery Labels are on in an instant—*without* moistening! No waste motions in handling or sorting loose labels—no messy gluing or wetting.

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Will not pop, peel or curl even under extremes of temperature and humidity—even stay neat and attractive with rough handling.

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In all industries . . . in hundreds of ways . . . Avery Labels are saving time, labor and money every day. Avery Labeling is geared to *your own* type of operation—either fast, production line speed or intermittent labeling.

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In terms of economy and improvement, actual case histories prove that Avery Labeling is the most economical method you can use in your production operations.

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Companies . . . People

also made president of **Pittsburgh Plastics Corp.**, West Pittsburgh, Pa., another recently acquired American Can subsidiary.

John Kempf appointed produce development manager of adhesives and coatings for **Furane Plastics, Inc.**, Los Angeles, Calif.

Bernard B. Bowling has joined **Seiberling Rubber Co.'s Plastics Div.**, Newcomerstown, Ohio, as a sales representative.

Thomas J. Egan, formerly with The Dow Chemical Co., now midwestern representative of the Petrochemical Div. of **Foster Grant Co.**, Leominster, Mass.

Richard Jarzombek, promoted to chief chemist of the Coatings Laboratory of **Logo, Inc.**, will be responsible for formulation of custom finishes, sales service, and evaluation and testing.

William J. Hogg appointed sales manager in charge of rubber chemicals and plastics of **Naugatuck Chemicals Div. of Dominion Rubber Co., Ltd.**, Elmira, Ont.

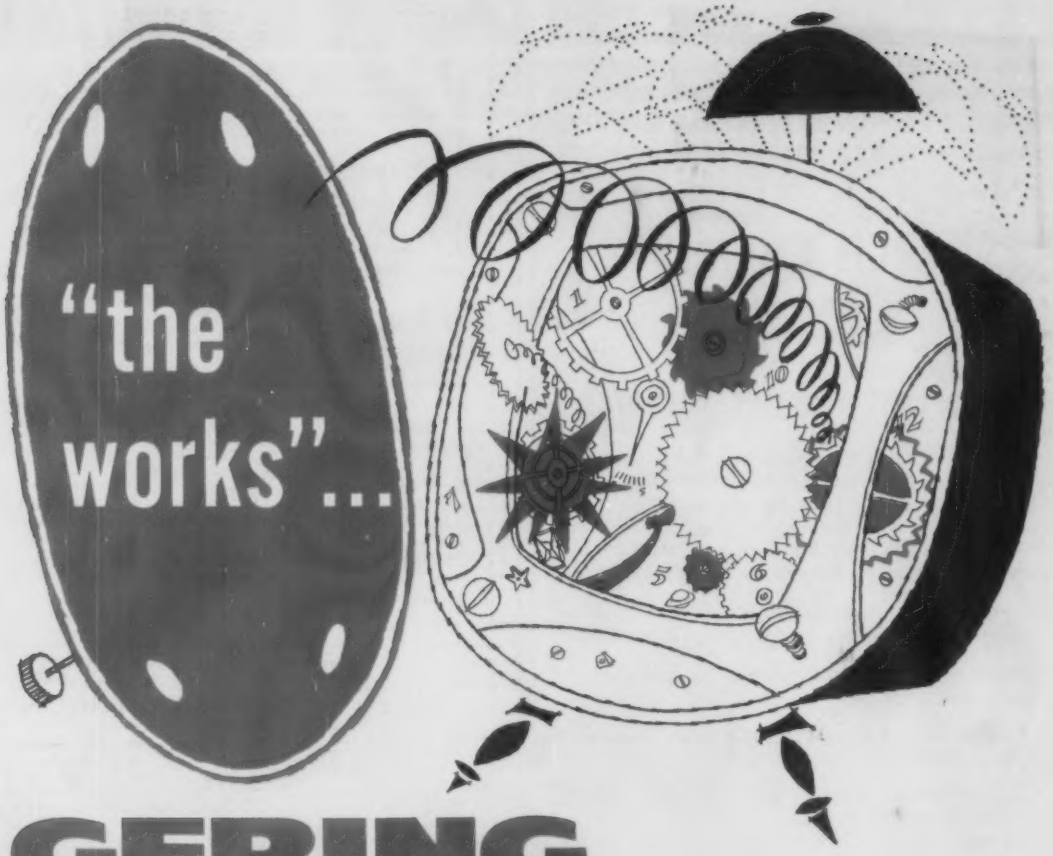
John M. Bills promoted to sales manager of **Cadillac Products, Inc.**, Ferndale, Mich. The company handles polyethylene bags, liners and specialties, cushioning materials, and industrial paper products.

Leverett A. Anderson appointed Ohio sales representative for **Whittaker, Clark & Daniels, Inc.**, 260 W. Broadway, New York, N. Y. He will headquarter in Akron. The company produces colorants, extenders, fillers, stearates, polishing compounds, etc. for the plastics and other industries.

Harold Melloy named territorial sales manager in the southeastern states for **Westmoreland Plastics Co.**, Latrobe, Pa., custom molder of plastics hardware for the appliance industry.

Howard B. Heinzen, formerly with Federal Machinery Sales Co., has joined **Hess, Goldsmith & Co., Inc.** as assistant to **Raymond F. Clark**, executive vice president, responsible for sales and service of woven fibrous glass fabrics for industrial end uses.

G. W. Fykes named southwest sales representative for **Southbridge Plastics, Div. of Golding Bros. Co., Inc.**, and will headquarter in Dallas, Texas. The company manufactures vinyl plastic sheeting under the tradename Vinalon.



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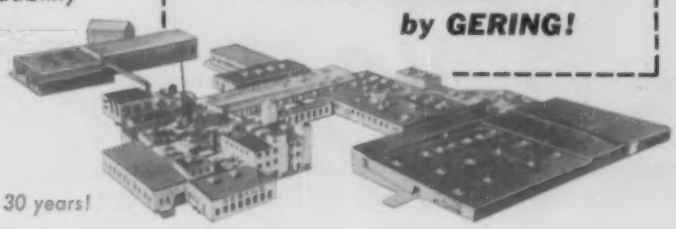

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For laboratory development, evaluation, and application of adhesives. BS in organic chemistry or chemical engineering. Ordnance or aircraft background desirable.

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For application, development, and evaluation of laminated and other reinforced plastics. BS in organic chemistry or engineering experience required.

PLASTICS PROCESS ENGINEER OR CHEMIST

With broad background in laminating, moulding, and casting resins and adhesives. Work with materials laboratory and prototypes shops in process development. Degree in organic chemistry or engineering experience required.

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You will like working for a leader that is looking ahead and growing. In addition to your salary, you expect a bonus, paid life and health insurance, and retirement benefits. You will enjoy the gracious living in a beautiful southern Wisconsin city—close to nature and close to metropolitan areas.

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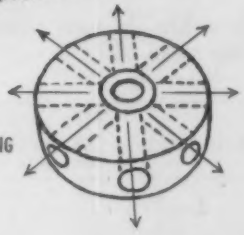
An 8 cavity automatic mold with 64 radially operated cores.



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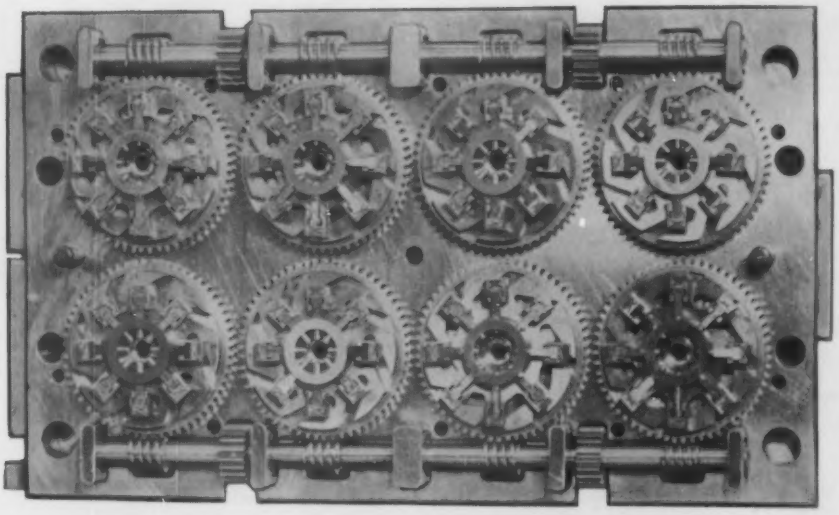

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J.G. TILP INC. UNION, N. J.

Superior Injection, Compression and Transfer Molds for Plastics

Mailing Address, Box 554, Union, N. J. MUrdock 6-7300

Classified Advertisements

Modern Plastics reserves the right to accept, reject or censor classified copy.

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Business opportunities

Equipment

Used or resale only

Machinery and equipment for sale

FOR SALE: Surplus Equipment. Injection Molding Machines up to 60 ounces. Impression Molding Presses. 50 ton, 12"x12" Laboratory Presses. Carver Laboratory Presses rebuild and guaranteed. 6"x13" Laboratory Mills. ¾" double solenoid control valve 3,000 p.s.i. Partial list. Send us your inquiries. Plastic Machinery Exchange, 426 Essex Avenue, Boonton, N.J. Tel.: DE. 4-1615.

FOR SALE: 3—150-Ton Stokes Presses complete with Bar Controls and Boilers; 1—D3 Rotary Preformer; 2—D4 Preformers; 1 Colton #3 Preformer. Merit Plastics, Lynbrook, New York.

FOR SALE: (6) 100 ton, 10" ram, 10" stroke @ $1250; (7) 200 ton. 9" stroke, 14" ram, 36x36, @ $2150; (6) 200 ton, 9" stroke, 15" ram, 30x30 @ $1850; (1) 50 ton complete, 18x18 @ $1850; (1) 200 ton 16" ram, 30x30 @ $2450; (2) 200 ton 16" ram, 42x42 @ $2850; (1) 200 ton, 15" ram, 42x42 @ $2600; (3) 250 ton (2) 12" ram, 30x60 rebuilt @ $3675. Hydraulic Sal-Press Co., Inc., 386-90 Warren Street, Bklyn, N.Y.

FOR SALE: 2—Baker Perkins 316 SS, 100 and 50 gal. jacketed, double arm Mixers; 6—Day 250 and 100 gal. double arm Mixers; 1—Robinson 90 cu. ft., 316 SS Powder Mixer; 2—Two Roll Mills 6"x12"; 8—Stokes Model DD2, DS3, D3 and B2 Rotary Preform Presses; 1—Stokes #294 single punch Preform Press; 4—Stokes Model "R" single punch Preform Presses; 1—Kux Model 15-25 Rotary Preform Press; Also: Sifters, Banbury Mixers, Powder Mixers, etc., partial listing; write for details; we purchase your surplus equipment; Brill Equipment Co., 2407 Third Ave., New York 51, N.Y.

FOR SALE: 1 Modern Plastics 1¼" electric extruder; 1 Stokes standard 150 ton molding press; 2 Cumberland 14" rotary choppers; 2 Stokes model R and T preform presses; 5 self-contained laboratory presses, 10, 30 and 50 tons; also mills, mixers, granulators, etc. Chemical & Process Machinery Corp., 52 Ninth St., Brooklyn 15, N.Y. Tel.: HY. 9-7200.

FOR SALE: 64 Oz. Injection Molding Machine with Pre-Plasticizer. 750 Ton Clamp. Mold Size 32" vertical, 50" horizontal. 8 & 4 oz. Injection Molders. Aaron Machinery Co. Inc., 45 Crosby St., New York 12, N. Y. Tel.: WAlker 5-8300.

LIQUIDATION.
Transfer Molding Presses
Late type-self contained
1—300 ton Stokes
2—200 Ton Baldwin-Southwark
2—150 ton Stokes
1—100 ton Stokes
Also 1—Defiance #20 Preform Machine
10—Thermall Preheaters.
Reply Box 2216, Modern Plastics.

MACHINERY FOR SALE: Injection Molding Machines (4). HPM and Reed. 2 ounce - 4 - 8 and 9. Can be seen in operation. Cash or terms. We are established molders. We want to buy 1—1952 24 ounce Reed. Victory Manufacturing Corporation, 1722 West Arcade Place, Chicago 12, Illinois.

FOR SALE: 1—6"x12" Laboratory Mill, m.d.; 1—Ball & Jewell Rotary Cutter, size 0 m.d.; 4—Horizontal Dry Powder ribbon Mixers, 2000#, 1500#, 800#, 500#; 1—Pfaudler 300 gal. G.L. Jack Agt. Reactor; 1—New 3 Roll 6"x16" Laboratory Calender; 1—Day 15 Gal. Pony Mixer, S.S. Cans, m.d.; 1—Day Imperial #30 Mixer, 75 gal.; 1—Mikro Pulverizer #2th, with motor; 4—Reed-Prentice & W-S Injection Molding Machines, 2-16 oz; Also other sizes: Hydraulic Presses, Tubers, Banbury Mixers, Mills, Vulcanizers, Calenders, Pellet Presses, Cutters. Send us your inquiries. What have you for sale? Consolidated Products Co., Inc., 50 Bloomfield Street, Hoboken, N. J. HOboken 3-4425, N.Y. Tel.: BArclay 7-0600.

FOR SALE: Dual Pumping Units in stock and Custom Built; Rebuilt Hydraulic Presses FOM 75-170 tons, platen area from 17x18, 18x29, 18x35; Baldwin Southwark 75-170 tons, 24x24; D&B 10-60 tons 12x12; Laboratory Presses, Preform Machines, etc. Universal Hydraulic Machinery Co. Inc., 285 Hudson Street, New York City 13.

FOR SALE: Cameron Slitter 72" CAMACHINE Type 26 Model 3-AM, V-belt drive complete with 5 H.P. Reliance V-S drive, drip proof protected, 218/1750 R.P.M. including jogging, dynamic loading, slide rails, 220/60/3 electricity 1 mil roll shaft, chucks for 3" I. D. by 3½" O. D. Two feed rolls (top roll rubber covered) 10 pneucut air slitter units complete with 10 extra slitter wheels ball bearings and axles, 2 differential rewind shafts for standard 3" I. D. x 3½" O. D. Attached mill roll apparatus with oscillating device without motor; 50 differential driving washers. Used less than two hundred hours, $8476.00. Reply Box 2228, Modern Plastics.

FOR SALE: Markem Printing Machine, high production, semi-automatic dial feed model 25AD-2C Printer. Suitable for imprinting plastics, paper, cloth, flat packages, products or parts. Immediate delivery. May be tested in operation. Reply Box 2212, Modern Plastics.

FOR SALE: COMPLETE: Raw material mixing plant for phenolic molding and similar lines. Never used. In original crates. 24"x60" Farrel Plastic two roll mills, gear reducer and drive; conveyors, premixers, sifters, valves, crushers, scale, blender, screen, dryer, dust collector, cutters. 800 T. Baldwin Hydr. Press: 42"x42" platens (11); 21" str. rebit. '57-; 26" ram. Eveready: Box 638; Bridgeport, Conn. EDison 4-9471—E. J. McCallum.

FOR SALE: 32 oz. Watson-Stillman, Model 650E. 1951; 20 oz. H.P.M., 1954; 16/20 oz. Reed-Prentice, 1956; 16 oz. W-S & H.P.M.; 12/16 oz. DeMattia, Model C, 1951; 12D-12 oz. Reed-Prentice; 8 oz. Reed-Prenitce, w/plunger advance, 1950, $8500; 8 oz. R-P, 1946, $6000; 8 oz. Lester w/solid frame, 1946, $5000; 8 oz. Fellows, 1953; 9 oz. H.P.M., 1946, w/weigh feeder; 8 oz. DeMattia, toggle type, very reasonable; 4 oz. Impco, 1951; 4 oz. Lester, $3000; 4 oz. H.P.M., 1946, $3500; 4 oz. Lewis, 1953, $4250; 4 oz. Impco, 1951; 2 oz. Moslo, Model 73; 2 oz. Van Dorn, lever type; 1 oz. Van Dorn, hand; 1 oz. vert. Watson-Stillman; 150 ton Stokes w/trans. ram; Auto-Vac vacuum forming mach., w/30"x50" moldable area & drape attach.; double-end tumblers; grinders; ovens, etc. Partial listing—other equipment available. Acme Machinery & Mfg. Co., 2315 Broadway, New York 24, N.Y. Tel.: SU. 7-1705.

FOR SALE: Vacuum Metallizers 36", 66". Injection Presses: 8, 12, 16 oz. Reed, 2, 4, 9, 16 oz. HPM, 8, 12 oz. Lester, 8 oz. vertical Gidding, 4 oz. Lewis, 1, 2 oz. Van Dorn. Extruders: 2½" oilhtd. NRM, 2½" Hartig. 24" & 30" Sheet Dies, 30" & 52" Pull-Off. 48" Sheet Stacker. 14" & 6" Dulmage Meter Pumps, Conveyors. Despatch 48" x 72" Sheet Preheat Oven. 6 Drawer- Despatch Preheat Oven. Grieve-Hendry Oven. Cumberland Model O grinder. — Apex 2 color Container Imprint. mach. — Compression & Transferpresses 50 to 600 T. — Elmes Hydroair press 30 T. — 2 & 5 KW Electronic Preheaters. Baker-Perkins 200 gall. Mixer. Vac. Forming mach. 40x60". List your Surplus equip. with me. All Midwest locations. Wanted 24 oz., 32 oz. Injection Presses and 1½" to 4½" Extruders. Justin Zenner, 823 Waveland Ave., Chicago 13, Ill.

FOR SALE: Stainless Steel Reactors 1425 gal., 465 gal.; Ribbon Mixers 336 and 56 cu. ft. working capacity, Fitzpatrick Comminuting Machines, Models D & F. Heavy Duty Sigma Blade Mixers Steel & Stainless Steel, 5 to 100 gal. Also Marco Process Extruders, Molding Presses, etc. Perry Equipment Corp., 1429 N. 6th St., Phila. 22, Pa.

FOR SALE: 800 ton laminating press with 23 openings 26"x38". Adamson 500 ton upstroke press 42"x42" platens. 300 ton laminating press with 10 openings 40"x40". 300 ton upstroke press 22"x35" platens. Farrel 200 ton 30x30 platens. 200 ton Hobbing Press 18"x14" platens. D & B 140 ton, 36"x36" platens. Adamson 80 ton, 20"x20" platens. Farrel 200 ton 20"x80" platens. French Oil 120 ton self-contained 18"x22" platens. W. S. 40 ton self-contained with 12"x12" elect. heated platens. Also Lab. to 2,000 tons from 12"x12" to 48"x48". Hydr. Pumps and Accumulators. Stokes Automatic Molding Presses. Van Dorn 1 oz. Injection Molding Machine. Kux 2½" dia., single punch preform machine. Mills and Calenders to 84". New Seco 6"x13" and 8"x16" Lab. Mixing Mills and Calenders. Plastic and Rubber Extruders, Oxford 57" Slitter. Rotary and single punch Preform Machines, ½" to 4" Injection Molding Machines 1 oz. to 60 oz. Baker-Perkins & Day Jacketed Mixers. Plastic Grinders. Gas boilers. Partial listing. We buy your surplus machinery. Stein Equipment Co., 107-8th Street, Brooklyn 15, N. Y. Sterling 8-1944.

(*Continued on page* 294)

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EXPORT AGENTS
INTERPLASTICS CORP.
120 East 56th Street
New York 22, N.Y.

(*Continued from page 292*)

PLASTICS MACHINERY

Cutters, Rotary, Plastic
Ball & Jewell #½, 10 HP MD, New 1954
Ball & Jewell #2 with 40 HP MD, Extra Knives

Extruders
Hartig 2" Elec. Htd., 7½ HP Reliance V-S Drive, 98% New
Hartig 3¼" Elec. Htd., 45" Barrel, 20 HP Reliance V-S Drive

Injection Molding Machines
2 Oz. Van Dorn, Oversize Cylinder, Model H-200
6 Oz. Watson-Stillman with 2 Wheelco Controls
16 Oz. Reed-Prentice No. 10-E-16, Elec. Htd., 1948

Mills, Rubber/Plastic
6" x 13" Lab Type with 5 HP MD
18" x 50" Farrel, Rubber/Plastic, 75 HP MD

Presses, Molding
15 Ton Baker Fully Automatic
15 Ton Stokes No. 200 D-2 Automatic (10)
15 Ton Stokes 200D-3
30 Ton Baker Full Automatic Model 958, Excellent Condition, New 1951
40 Ton Francis, 4 Opening, 12" x 12" Elec. Heated Platens
50 Ton Stokes, Semi-Auto., Self Cont.
100 Ton Stokes Standard Semi-Automatic, Power System, Timing Controls
100 Ton Lake Erie Hi-Speed, 24" x 24" Bed, 12" DLO, Self. Cont.
113 Ton French Oil Mill, 6 Opening, Elec. Htd. Platens 15" x 18"
113 Ton R.D. Wood, 5-Opening Elec. Htd. Platens 14" x 20"
150 Ton Stokes Standard Semi-Automatic, Power System, Timing Controls
175 Ton Vicaroy Slab-Side 24" x 24", Elec. Htd. Platen with rland Pump
200 Ton Stokes Semi-Automatic, Power System, Timing Controls
225 Ton Farrel 14" Ram x 18" Stroke, L-R 26½" x F.B. 24½" 7½ HP MD
300 Ton Watson-Stillman Transfer Press, 33½" x 27" Platen, Main Ram 18" Dia. x 18" Str., Self-Contained
300 Ton Stokes Semi-Automatic, Power System, Timing Controls
625 Ton Farrel, Steam Platens 52" x 52", Pump, Mtr., Controls, Under Power
669 Ton, Morane, 3 Upmoving Rams. 16" Stroke
1200 Ton HPM, 15 Openings, 100" x 120" Steam Platens, Self-Cont. (2)
4000 Ton Mesta, 3 Upmoving 30" Rams x 20" Str. Bed 34" x 351"

Presses, Hobbing
400 Ton Robertson, 13" Ram x 4" Stroke complete with pumps & 15 HP MD

Furnaces and Ovens
Megatherm, 3/60/220, 5 EN, 2-3 lb. Phenolic Per Min. (8)
Despatch Mdl. P1hd-8 8 Drawers, 12 x 18 x 2½" (2)
GE High Frequency Plastic Preheater Model 4-HB2A1

Tablet Machines
Model "E" Stokes, Complete with MD
Model R Stokes, Single Punch, Variable Speed Motor Drive, 3 HP
No. RB-2 Stokes, 16 Station, Motor Drive, 2 HP
Model 45 Defiance, 200 Ton, 15 HP, Vari-Speed, MD
Model F, Stokes, Single Punch, MD
No. 5 Arthur Colton, Motor Drive, 3 HP
No. DDS-2 Stokes, 23 Stations, US Vari-Drive, 10 HP
Model T Stokes Hydraulic Equalizer, MD

Mixers
No. 3A Banbury, 150 HP Md Rubber/Plastic
No. 3 Banbury 75 HP MD Excellent Condition Slide Door Construction

Calenders
24" x 48" Farrel-Birmingham, 3 Roll, 50 HP DC Motor
9" x 48" American Tool 4 Roll Doubling, Belt Drive
6" x 13" Elec. Htd. 6 Roll Lab type, 7½ HP MD

Pelletizers
Mitts & Merrill Model 10-N-6 15 HP V.S. Drive

Make Us Your Prime Source for All Types of Plastics Machinery

Hydraulic Presses from lab size to 5,000 ton
Injection Molders from ¼ oz. to 60 oz. size
Extruders from lab size to 12"
Plastic & Rubber Mills and Calenders up to 84" size
Tablet Preform Presses, single punch and rotary, all sizes
Mixers all sizes, types and capacities

Also a complete selection of tumbling barrels, take-up equipment, hydraulic power units, pumps, ovens, blenders, scrap cutters, pelletizers, coating equipment and laminating equipment.

JOHNSON MACHINERY Co.
683-P Frelinghuysen Ave., Newark, N.J.
What Do You Need? What Have You to Sell?

SALE: Hydr.-Presses; Baldwins 160 ton, 16"x18" 500 ton 36"x36". Lake-Erie Molding 150 ton F.O.M. 500 ton 30"x30". Power-Units in stock to order. We want (12) 400 tons, 24" Stroke all alike, (3) 300 ton, W. or W/o Platens 54"x28". List surplus presses for fast action, Hydraulics Industrial Engineering Service, 2020 Renfrew, Elmont, N.Y.

FOR SALE: Available at bargain prices: Baker Perkins 50 gallon Steel and Stainless Steel Steam Jacketed Heavy Duty Mixers with Stainless Jacketed Blades, motorized power tilting, motor driven. W & P 200 gallon Heavy Duty Mixer, tilting type, with Sigma Blades. J. H. Day from 1 qt. to 150 gal., Imperial and Cincinnatus D.A. Jacketed, Sigma Blade Mixers. Day 15 to 10,000 lbs. Dry Powder Mixers. Mikro Bantam, 1SH, 1F, 2TH, 3TH Pulverizers. Day, Rotex, Tyler-Hummer, Great Western Sifters. Package Machy. FA, FA2, FA4, Miller, Hayssen, Scandia, Hudson Sharp, Oliver Auto. Wrappers—all sizes. This is only a partial list. Over 5000 machines in stock available for immediate delivery. Tell us your machinery requirements. Union Standard Equipment Co. 318-322 Lafayette St., New York 12, N.Y.

Machinery and equipment wanted

WANTED: HYDRAULIC PRESS—250-450 ton—multi opening—30"x60" platens or larger. Will sell Ball & Jewell #1 Cutter. Reply Box 2207, Modern Plastics.

WANTED: 32 oz. Injection Molding Machine in good condition. This is for our own manufacturing requirements. Please advise. Reply Box 2227, Modern Plastics.

SPECIALIZED FRENCH FIRM. Possessing commercial departments, office in Paris and overhaul workshop looking for constructors manufacturing equipment for industries converting Plastics in order to conclude agreement for a selling agency or representatives in France and French Union. Le Matériel "DOG"—Société J. Moreau & Cie 16, avenue Hoche, Paris 8e, France.

WANTED: Good used 12 or 16 oz. HPM, Watson-Stillman (1950 or later) or Reed Prentice (1951 or later). Must be in operating condition and priced under $15,000. Advise location, serial number or age, complete specifications and asking price. L. D. Blackwell, Blackwell Plastic Molding Co., Inc., 5606 Cavanaugh St., Houston 21, Texas. Phone OLive 4-6577.

WANTED: Used 8" Extruder, Good Condition, with a Vinyl Screw. Reply Box 2226, Modern Plastics.

MACHINERY WANTED: Hydraulic Press used, with 8 or 10 daylite openings, 22"x52" or 24"x54", complete with pumps and accessories. Reply Box 2221, Modern Plastics.

WANTED: by Injection Molder Used Lewis or Reed 4 or 8 ounce 4 to 5 years old. Prefer Reed 10A4. Reply giving serial number, age, approximate hours used and condition to Southeastern Plastics, Inc., 100 Victory Boulevard, Portsmouth, Virginia.

Materials wanted

WANTED.
Plastics Scrap and Rejects of all kinds. Ground and unground. Also rejected molded pieces and surplus virgin molding powders. Top prices paid.
Reply Box 2201, Modern Plastics.

PLASTIC SCRAP WANTED: All types and grades, any quantity. Write or telephone, Success Plastics Recovery Works, Inc., Post Office Box 506, Indianapolis 6, Ind. Phone Liberty 6-2919.

WANTED.
Vinyl, polyethylene and styrene scrap for our manufacture of molding and extrusion compounds. We can use rigid from vacuum forming, lumps, bleeder, slabs, trimmings, rejects—anything suitable for reprocessing. Send samples and details or telephone. Steady buyers since 1940.
Rotex Rubber Company, Inc.
1-23 Jabez Street, Newark 5, N.J.
MArket 4-4444

YOUR BEST MARKET for Surplus Molding Powders and Scrap Plastics—Gem City Trading. Contact Gem City for best prices on polyethylene, styrene, nylon, butyrate and acetate.
Gem City Trading—P. O. Box 941
Dayton 1, Ohio—HEmlock 2121

WANTED—SCRAP.
Acrylic, Acetate, Styrene, Rigid Vinyl.
Claude P. Bamberger, Inc.
Not Connected with any other Firm of Similar Name.
One Mount Vernon Street
Ridgefield Park, N.J.

Molds for sale

FOR SALE: Complete line of Houseware Molds, Comb Molds, also some novelty and specialty items. No reasonable offer refused. Send for list. Reply Box 2210, Modern Plastics.

FOR SALE: Doll Molds—for 7¼" baby doll-moveable arms, legs. Molds for large walking doll. Art Plastics Co., Inc., 511 Lancaster St., Leominster, Mass.

FOR SALE: A number of Compression Type Plastic Molds, to produce Ashtrays, Cigarette Caskets, Household Articles, Lipstick Cases, Flapjacks and Fancy Goods etc. All Molds in good condition. A once-in-a-lifetime bargain for an established manufacturer, or a rare opportunity for someone, entering the manufacturing field. Write for complete information. Reply Box 2224, Modern Plastics.

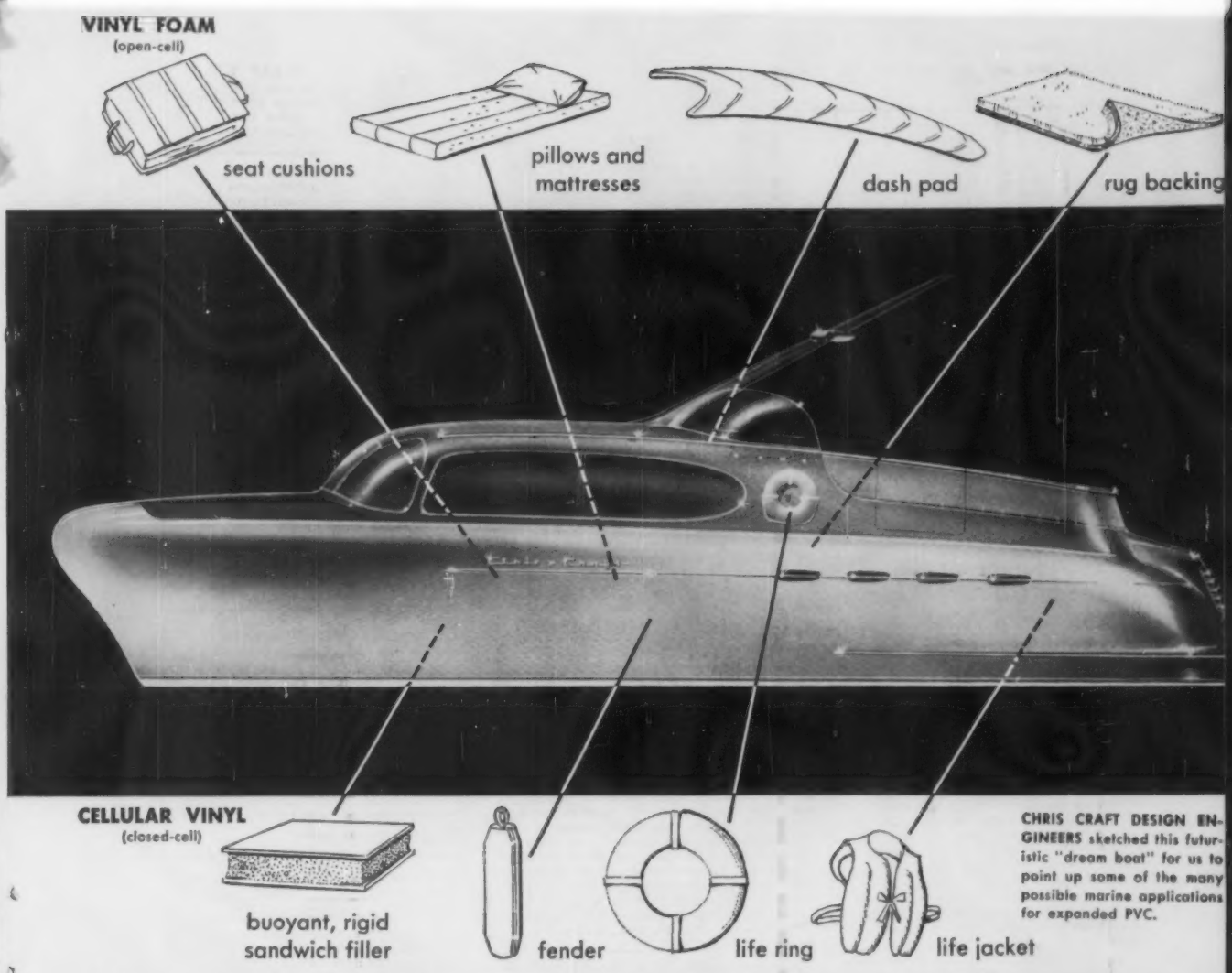
Help wanted

ELECTROFORMING:
Exceptional opportunity for experienced man to take charge of department producing spray masks, Molds For Plastics and specialized heavy plating for industry. Established growing company in Mid West. Give experience, education and remuneration desired in first letter. All replies strictly confidential. Reply Box 2220, Modern Plastics.

CHEMIST: (R&D) Sponge rubber and foams compounding. An excellent opportunity to grow with an expanding and progressive midwest organization. Reply Box 2225, Modern Plastics.

ASSISTANT PLANT SUPERINTENDENT: For expanding thermoplastic custom extrusion plant in Chicago. Salary dependent upon experience. If you qualify as Number 1 man to our plant superintendent write resume of education, experience and past earnings to Box 2217, Modern Plastics. All information kept confidential. Our employees know of this ad.

(*Continued on page 296*)



CHRIS CRAFT DESIGN ENGINEERS sketched this futuristic "dream boat" for us to point up some of the many possible marine applications for expanded PVC.

Aboard this dream cruiser are many possible uses for vinyl foam and cellular vinyl made with DuPont BL-353

From fittings for luxury yachts to toys and novelties at the nearest "five and dime," the market for vinyl foam and cellular vinyl grows bigger every day.

Many Uses

Here, for example, are a few other possible uses for chemically expanded vinyls:

1. Automotive protective padding
2. Rug and Carpet backing
3. Insulated clothing
4. Furniture and upholstery padding
5. Soles and interlinings for shoes
6. Athletic padding
7. Heat-sealable fillers

Advantages of Du Pont BL-353

This general-purpose blowing agent produces vinyl foam and cellular vinyl with fine, uniform cells in either thick or thin sections over a broad range of densities. It also offers excellent expansion efficiency in producing items of either vinyl foam or cellular vinyl. And when making free-blown vinyl foam with Du Pont BL-353, there is no need for specialized processing equipment.

DU PONT BL-353

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(Continued from page 294)

HELP WANTED FOR EUROPE.
We are one of Europe's largest and oldest plastics manufacturer, specializing in reinforced thermosetting products; presently translucent building panels only.
The man we need should have ground floor background with polyester resins and reinforcing materials. Chemical experience would be helpful. We expect this man to have broad experience and know-how in all phases of hand lay-up as well as forming and molding operations. He must also know the application of gel-coats.
We would employ this man as a technical advisor for 6 months, with the possibility to develop a long-term position as a technical director thereafter.
This position is open at our headquarters and plant, located in the most beautiful part of Western Germany. German language helpful but not necessary.
Only applicants submitting longhand applications, complete resume, references and salary suggestions will be considered. All replies strictly confidential.
A personal interview will be arranged for during the first half of May in New York.
Reply Box 2218, Modern Plastics.

PRODUCT DEVELOPMENT—POLYESTERS.
BS in Chem. or Chem. Engineering—2-4 years experience in resin compounding and formulation. Application of present company resins to industry. Product Development Department of progressive chemical company active in polyester field. Excellent opportunity for growth. New research center soon to be completed offers excellent working conditions in suburban Wilmington. Send resume and salary history to:
Employment Manager
Atlas Powder Company
Wilmington, Delaware

PLASTICS ENGINEER OR MECHANICAL ENGINEER interested in plastics: Excellent opportunity in Southeastern U.S. with well-established company that has recently branched into plastic injection molding and extrusion. Responsibility includes design, alteration and repair of injection molds, and design and cost estimates of new plastic products. Experience desired but not absolutely essential. Replies held in strict confidence. Salary open and excellent fringe benefits provided. Reply Box 2204, Modern Plastics.

CHEMIST: 1-3 years experience for evaluation of polyester resins, polyurethanes in reinforced plastics, elastomers and foams.
American Alkyd Industries
Broad and 14th Streets
Carlstadt, New Jersey.
GEneva 8-4332.

EXTRUSION SPECIALIST: Man with knowledge of all phases of the extrusion field, including machine set-up, die design, ability to handle people. Reply Box 2202, Modern Plastics.

APPLICATIONS RESEARCH CHEMIST.
Progressive chemical manufacturer, acknowledged leader in its field, requires experienced chemist or engineer capable of formulating, testing, and evaluating company's new products as functional additives to plastics and other materials. This is a key position in our market development group and will involve field contact and process demonstration. Western New York location. Reply Box 2200, Modern Plastics.

CHEMISTS.
Exceptional opportunities are available for capable Chemists or Chemical Engineers in our expanding applied research and product development program. Diversity of products in the rubber, plastics, bonding agents, and finishes fields offers challenging work and ample opportunities for professional advancement. We prefer men with M.S. or Ph.D. degrees with plenty of brain power who also have potential for administrative growth. Applicants may range in experience from recent graduates to those who are ready to be group leaders. Attractive salaries and benefits available. Interview and relocation expenses paid. Send resume and present salary to Box 2209, Modern Plastics.

CHEMIST WANTED: Product development. Man with resin formulating experience in paints, plastics, and adhesives desired, with imagination and ability to carry on development work with a minimum of supervision. Salary commensurate with experience and initiative. Reply to T. F. Harland, Mastic Asphalt Corporation, 131 S. Taylor St., South Bend 24, Indiana.

THE EXECUTOR OF AN ESTATE requires a thoroughly experienced man to manage a plant with four large injection molding machines. Man must know: Operational Molding technique; Be familiar with Plastics Engineering; Be conversant with maintenance; Have sales and Management personality; Take complete charge of operations of plant. This is opportunity of a lifetime for a capable man willing to relocate in Western Pennsylvania city, and be solely responsible for competent operation of plant. Reply Box 2208, Modern Plastics.

EXTRUSION PLANT SUPERINTENDENT: Experienced extrusion operator or foreman ready to move up to superintendent for new extrusion company. Must have knowledge of die design and setup on shapes, rods, tubes and sheet. Salary, bonus and fringe benefits, help with moving expenses. New NRM extruders, nice people to work with. Quick Plastics, Jackson, Michigan.

WANTED—FOREMAN.
Injection Molding Plant.
Would you like to live in a small city in Western Michigan with excellent schools, living conditions and recreational facilities? We need a foreman with experience in injection molding who is well qualified to work with and instruct people. Plant has operated over a decade and continuously expanded. We are custom molders with an outstanding reputation. In reply, give complete information about yourself and your employment history.
Reply Box 2205, Modern Plastics.

FOREMAN: Electronic Sealing Dept. Man capable of setting up dies and maintaining the equipment. Permanent position, unlimited opportunities with a modern aggressive Chicago Plant. First letter must incorporate all qualifications, references, salary desired and snapshot or photo. Replies held in strictest confidence. Reply Box 2203, Modern Plastics.

PLASTICS:
Manufacturer specializing in reinforced plastics and honeycomb structures has opening for experienced plastics sales engineer with good sales contacts in our field. Please give experience resume and present salary. Reply Box 2206, Modern Plastics.

Situations wanted

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Index of Advertisers

May 1957

Modern Plastics, 575 Madison Avenue, New York 22, N. Y.

267 Acheson Dispersed Pigments Co.
264 Acromark Company, The
Allied Chemical & Dye Corp.
166, 167 Barrett Division
81, 215 National Aniline Division
205 Semet-Solvay Petrochemical Division
60 American Airlines Airfreight
American Cyanamid Company
149 Plastics & Resins Division
270 American Latex Products Corp.
200 American Molding Powder and Chemical Corporation
66 American Petrochemical Corp. Mol-Rez Division
217 American Steel Foundries Elmes Engineering Division
285 Anchor Plastics Co., Inc.
284 Angier Adhesives, Div. of Interchemical Corporation
32 Argus Chemical Corporation
223 Atlas Powder Company, Chemicals Division
211 Automatic Molding Machine Company
290 Avery Adhesive Label Corp.

83 Baker Brothers, Inc.
177-179 Bakelite Co., A Div. of Union Carbide and Carbon Corp.
222 Barber-Colman Company
212 Barron, J. E., Plastics, Inc.
71 Battenfeld
69 Bellows Co., The
145 Berstorff, Hermann
96, 97 Blaw-Knox Company, Chemical Plants Div.
74 Boonton Molding Co.
91 Borg-Warner, Marbon Chemical Division
57 Bridgeport Moulded Products, Inc.
279 Brown-Allen Chemicals, Inc.
245 Buss Machine Works
271 Byrd Plastics, Inc.

283 Cadet Chemical Corp.
7 Cadillac Plastic and Chemical Co.
203 Cambridge Instrument Co., Inc.
33 Cameron Machine Co.
180 Carbide and Carbon Chemicals Co., A Div. of Union Carbide and Carbon Corp.
226 Carmer Industries
277 Carver, Fred S., Inc.
282 Cast Optics Corporation
1 Catalin Corp. of America
292 Celanese Corp. of America
189 Chemical Division
244 Export Division
18, 19 Plastics Division
38 Textile Division
173 Chemore Corporation
4 Chicago Molded Products Corp., Campco Division
258 Claremont Pigment Dispersion Corp.
105 Clark, Cutler, McDermott Co., Air-Loc Division
294 Classified
264 Columbian Carbon Company
222 Comet Industries
42 Commercial Plastics & Supply Corp.
243 Consolidated Electrodynamics Corp.
231 Continental Oil Company
239 Cosmos Electronic Machine Corp.
163 Crucible Steel Company of America
6 Cumberland Engineering Company, Inc.
212 Cylinder Mfg. Co.

51 Davis, Joseph, Plastics Co.
90 Davis-Standard, Div. of Franklin Research Corp.
236 Dawson, F. C., Engineering Co.
236 Detroit Mold Engineering Co.
247 Detroit Stamping Company
279 Devcon Corporation
Diamond Alkali Company
161 Chlorinated Products Div.
304 Plastics Division
261 Dow Chemical Company, The
221 Dowding & Doll Ltd.
du Pont de Nemours, E. I. & Co. (Inc.)
10, 11 Polychemicals Department
297 Explosives Dept.
2nd Cover Durez Plastics Division, Hooker Electrochemical Co.

262 Eagle Signal Corporation, Industrial Timers Div.
225 Eagle Tool and Machine Co.
85, 143 Eastman Chemicals Products, Inc.
94 Egan, Frank W., & Company
217 Elmes Engineering Division, American Steel Foundries
186 Electro-Technical Products Division of Sun Chemical Corporation
78, 79 Emery Industries, Inc.
303 Emhart Manufacturing Co., Henry & Wright Division
175 Enjay Company, Inc.
235 Erie Engine & Mfg. Co.
77 Erie Plastics Division, Erie Resistor Corp.
101 Escambia Chemical Corp.
54 Exact Weight Scale Co., The

90A Farbwerke Hoechst AG.
171 Farrel-Birmingham Company, Inc., Watson-Stillman Press Division
39 Fellows Gear Shaper Co., The
153 Ferro Chemical Corporation
Ferro Corporation
301 Color Division
201 The Patterson Foundry and Machine Co. Subsidiary
257 Fiberfil, Inc.
254 Fiberite Corporation, The
184 Fine Organics, Inc.
61 Firestone Plastics Company, Chemical Sales Division
295 Flightex Fabrics, Inc.
226 Flodins Industri AB
55 Foster Grant Co., Inc.
90 Franklin Research Corp., Davis-Standard Div.

12 General American Transportation Corporation, Parker-Kalon Div.
4th Cover General Electric Company
67 General Industries Co., The
82 Georgia Kaolin Company
291 Gering Products, Inc.
195 Girdler Company, The
281 Glass Yarns and Deeside Fabrics Ltd.
Glidden Company, The
49 Chemicals–Pigments–Metals Division
219 Industrial Finishes Division
3, 106 Goodrich, B. F., Chemical Co.
14, 15 Goodyear Tire & Rubber Company, The
238 Goulding Manufacturing Co.
104 Grace, W. R., & Co. Polymer Chemicals Division
207 Granbull Tool Co. Ltd., The
29 Grauert, Ralph W., Inc.
202 Gries Reproducer Corp.
283 Guild Electronics, Inc.

25 Hannifin Corporation
228 Harchem Division, Wallace & Tiernan, Inc.
76, 86 Harshaw Chemical Co., The
280 Hart-Carter Co.
265 Heppenstall
26, 27 Hercules Powder Company, Cellulose Products Dept.
278 Hinde & Dauch
203 Hobbs Manufacturing Co.
2nd Cover Hooker Electrochemical Company, Durez Plastics Div.
21 Hydraulic Press Mfg. Co., The, A Div. of Koehring Co.

65 Imperial Chemical Industries Ltd., Plastics Division
272 Improved Machinery Inc.
277 Industrial Heater Co., Inc.
269 Industrial Plants Corp.
245 Industrial Plastic Fittings Co.
238 Industrial Research Labs.
20, 269 Injection Molders Supply Co.
284 Interchemical Corp., Angier Adhesives Div.
277 Interplastics Corporation

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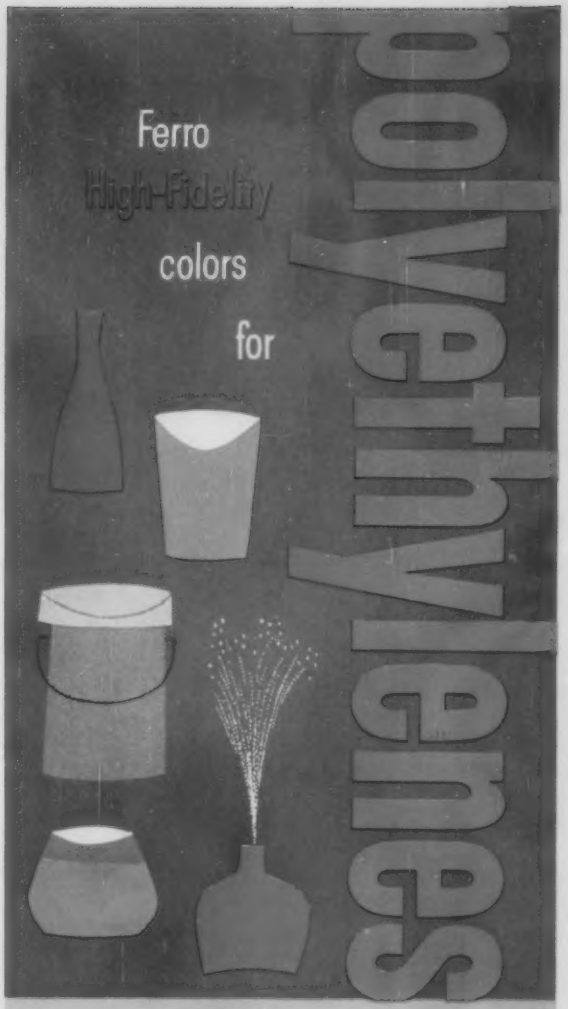

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Ferro Enamels (Canada) Ltd., Oakville, Ontario, Canada

185 Jamison Plastic Corp.
213 Jay, T. V., Company
294 Johnson Machinery Co.

271 Kaufman Glass Company, Plastics Division
185 Kentucky Color and Chemical Company, Inc.
30 Kleen-Stik Products, Inc.
46 Koppers Company, Inc., Chemical Division
17 Kurz-Kasch, Inc.

34 L. O. F. Glass Fibers Company
279 Lembo Machine Works, Inc.
31 Lester-Phoenix, Inc.
56 Lewis Welding & Engineering Corp., The
202 Liberty Machine Co., Inc.
240 Litzler, C. A., Co., Inc.
242 Lucidol Division, Wallace & Tiernan, Inc.

204 Manco Products, Inc.
229, 230 Manufacturers' Literature
156 Marblette
91 Marbon Chemical, Division of Borg-Warner
197 Markem Machine Co.
224 Marvel Engineering Company
234 Mayflower Electronic Devices, Inc.
75 Meiki Co., Ltd.
233 Merck & Co., Inc., Chemical Division
254 Mercury Molding Machinery, Inc.
62 Mereen-Johnson Machine Co.
203 Metalsmiths
98 Metal & Thermit Corp.
13 Modern Plastic Machinery Corp.
66 Mol-Rez Division, American Petrochemical Corp.
92, 93 Monsanto Chemical Company, Organic Chemicals Division
286, 287 Plastics Division
241 Mosinee Paper Mills Co.
36 Moslo Machinery Company
84 Mount Vernon Mills, Inc., Turner Halsey Company
35 Muehlstein, H., & Co., Inc.

81, 215 National Aniline Division, Allied Chemical & Dye Corp.
24 National Lead Company
216 National Polymer Products, Inc.
87 National Rubber Machinery Company
159 Naugatuck Chemical Division, United States Rubber
100 Negri Bossi & Co.
187 Newark Die Hobbing and Casting Co.
102 Newbury Industries, Inc.

284 Orange Products, Inc.
70 Oronite Chemical Company

12 Parker-Kalon Div., General American Transportation Corp.
292 Parker Pen Company, The
201 Patterson Foundry & Machine Co., The, A Subsidiary of Ferro Corp.
48 Peerless Roll Leaf Co., Inc.
254 Perforating Industries, Inc.
225 Peter Partition Corp.
37 Petro-Tex Chemical Corp.
72, 73 Phillips Petroleum Company Phillips Chemical Co., Div.
199 Pitt-Consol Chemical Co.
3rd Cover Pittsburgh Coke & Chemical Co.
23 Plastics Engineering Co.
234 Plastic Molding Corp.
295 Plastic Molders Supply Co., Inc.
227 Pyrometer Instrument Co., Inc.
245 Preis, H. P., Engraving Machine Co.
272 Price-Driscoll Corp.
235 Process Equipment Company

210 Radial Cutter Mfg. Corp.
22 Raybestos-Manhattan, Inc., Asbestos Textile Division
269 Reed Plastics Corporation
8 Reed-Prentice
183 Reichhold Chemicals, Inc.
16 Reifenhäuser, A.
190 Reliance Electric & Engineering Co.
213 Resin Research Labs., Inc.
232 Robbins Plastic Machinery Corp.
191 Robertson, H. H., Co.
246 Rogers Corporation
53, 147 Rohm & Haas Company
103 The Resinous Products Div.
242 Royle, John, & Sons
251 Rubber & Asbestos Corp.
240 Rubber Corp. of America

292 Sandia Corporation
253 Sarco Company, Inc.
299 Schulman, A., Inc.
44 Schwartz Chemical Co., Inc.
214 Sealomatic Electronics Corp.
276 Seiberling Rubber Company, Plastics Division
205 Semet-Solvay Petrochemical Div., Allied Chemical & Dye Corp.
50 Shaw, Francis, & Co. Ltd.
40 Shell Chemical Corporation
200 Sinko Mfg. & Tool Co.
28 Spencer Chemical Company
274 Standard Tool Co.
237 Stanley Chemical Company
239 Star Manufacturing, Inc.
301 Sterling, Inc.
58, 59 Stevens, J. P., & Co., Inc.

204 Sticht, Herman H., Co., Inc.
138, 139 Stokes, F. J., Corporation
283 Stricker-Brunhuber Corp.
186 Sun Chemical Corporation, Electro-Technical Prod. Div.

95 Tennessee Products & Chemical Corporation
185 Thermo Electric Co., Inc.
264 Thermomat Co., Inc.
293 Tilp, J. G., Inc.
80 Timken Roller Bearing Co., The
200 Thoreson-McCosh, Inc.
64 Tupper Corporation

275 Union Bag-Camp Paper Corp.
177-179 Union Carbide and Carbon Corporation
Bakelite Company Div.
180 Carbide and Carbon Chemicals Company Div.
196A, 196B Union Carbide International, Company Division
63, 209, 263 U. S. Industrial Chemicals Co.
United States Rubber Co.
206 Collapsible Container Div.
159 Naugatuck Chemical Div.

193 Van Dorn Iron Works Co., The
266 Vlcheck Tool Co., The, Plastics Division
233 Vogt Manufacturing Corp.

249 Waldron, John, Corporation
Wallace & Tiernan, Inc.
228 Harchem Division
242 Lucidol Division
289 Watertown Manufacturing Co., The
273 Watlow Electric Mfg. Co.
196 Watson-Standard Co.
171 Watson-Stillman Press Div., Farrel-Birmingham Co., Inc.
134 Welding Engineers, Inc.
9 Wellington Sears Co.
59 Westchester Plastics, Inc.
208 West Instrument Corporation
272 Western Felt Works
242 Western Supplies Company
88 Wiegand, Edwin L., Co.
247 Williams, George A., & Son
281 Williams-White & Co.
248 Wilner Wood Products Co.
169 Wood, R. D., Company
68 Worbla Ltd.
99 Wrenn Paper Co., The

MODERN PLASTICS

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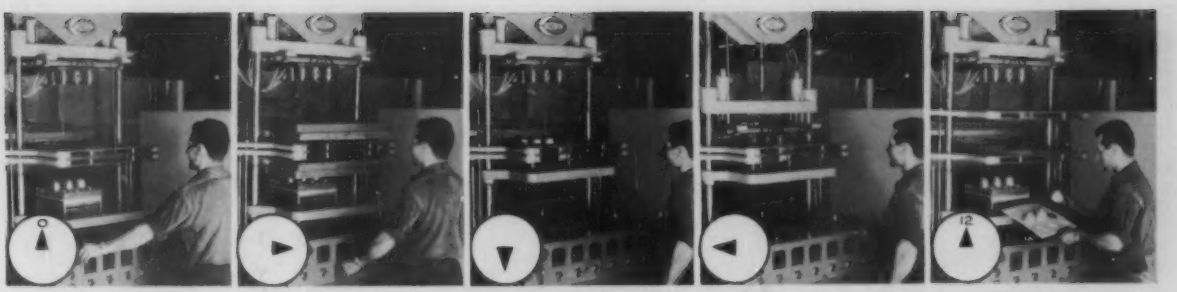

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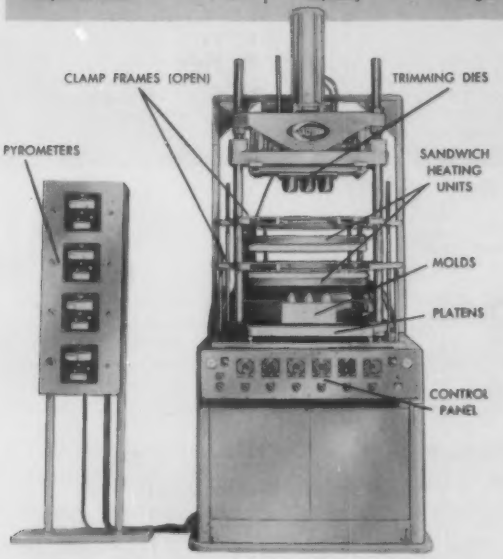

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